كيمياء المتميزين

شرح مفصل
ترجمة علمية

مع النجم في الكيمياء

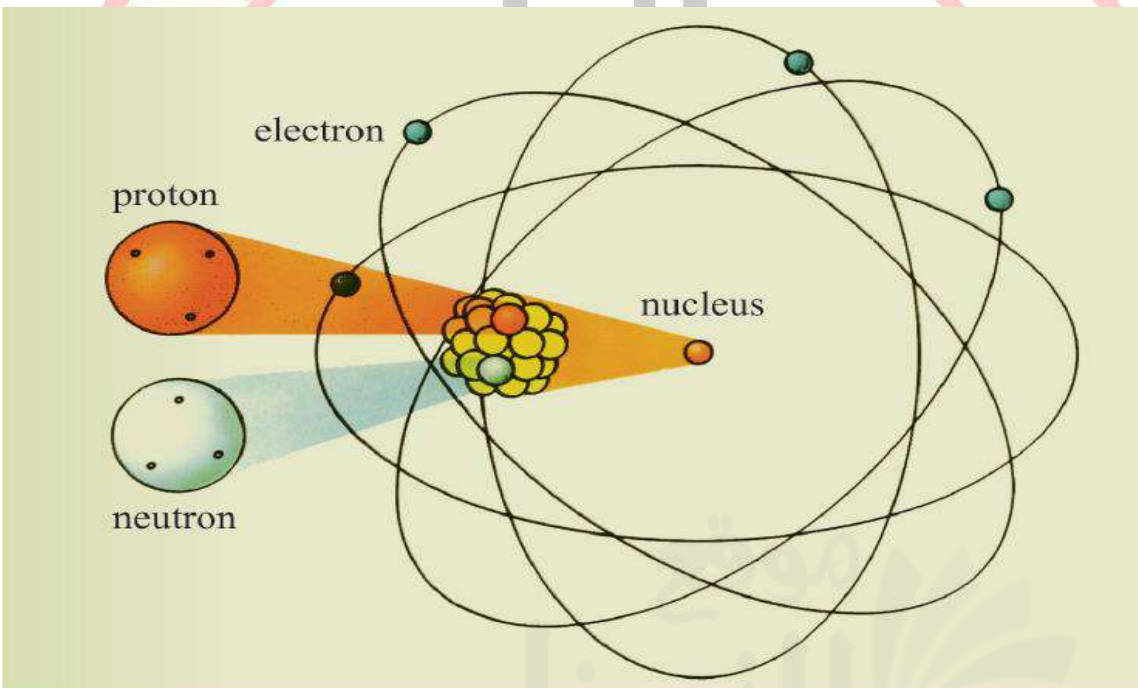
الصف الثالث متوسط

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كلية بغداد

Chapter 1

Chapter 1

ATOMIC STRUCTURE FOR MATTER



ماذا كلمة الذرة تدعى اللاتينية

Q / What is the word "Atom" called in Latin?

الجواب تعني غير قابل للانقسام

Answer: It means indivisible.

وضح تطور مفهوم الذري الهيكل

Q/ Explain the Evolution of the concept of the Atomic Structure.

وفقاً ل

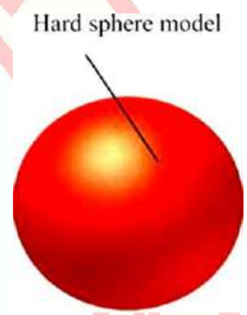
According to :

دالتون نموذج

A- Dalton's Model:

عند بداية قرن دالتون اقترح

At the beginning of the 19th century, Dalton perceived



الذرة قوي غير قابل للانقسام جسم كروي

1. The atom as a hard, indivisible sphere

كل عنصر يمتلك محدد نوع من ذرات

2. Each element has a specific kind of atoms.

هذه الذرات هي ارتبطت من خلال بسيطة

3. These atoms are connected through simple

عمليات ل تشكل مرتبطة ذرات

methods to form combined atoms.

ثومسون نموذج

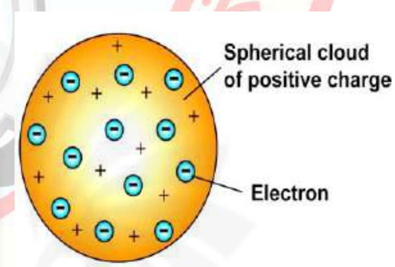
B- Thomson's Model:

عند نهاية 19 القرن ثومسون

By the end of the 19th Century, Thomson

أعط أخر تصور ل ذرات

gave another perception of the atom.



الذرات تحتوي اصغر جسيمات تمتلك

1- atoms consist of smaller particles having

سالبة شحنة تدعى الإلكترونات

negative charge ,called (electrons)

الذرة هي إيجابيا مشحونة جسيم كروي التي

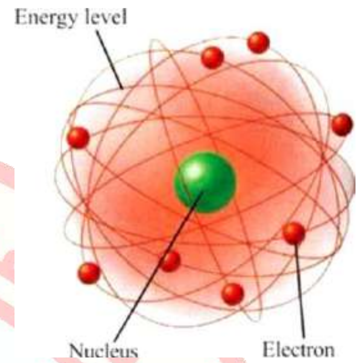
2- The atom is a positively charged sphere on which

سالبة المشحونة إلكترونات منجذبة ل تعادل ال شحنة

negatively charged electrons attached to balance the charge.

نموذج رذرفورد

C- Rutherford Model:



ال بعد و القرن العشرون أوائل في

In the early 20th Century, and after the

البروتون اكتشف

discovery of the proton

تـــــصــــــوره قدم رذرفورد

Rutherford introduced his perception that:

كتلة ال الجسيم المشحون إيجابيا (موجب)

1. (A positively charged particle, the mass of

الالكترون ذلك من اكبر هي البروتون

proton is greater than that of the electron).

الذرة مركز في مساحة صغيرة جدا" في يقع البروتونات

2. protons are situated in a tiny area at the center of the atom

الذرة كتلة اغلب تحتوي التي النواة تدعى

called the nucleus which contains most of the mass of the atom

معظم فان لذلك النواة حول تدور الالكترونات

3. The electrons circle around the nucleus. Therefore, most of the

الألكترونات السالبة عدد يُلغى الذرة حجم

volume of the atom is avoid, the number of negative electrons

الشحنة الموجبة يعادل النواة حول تدور

rotates around the nucleus balance the positive charge of

للبروتونات

protons.

مع مدارات مختلفة في النواة حول تدور الألكترونات هذه

4. These electrons rotate around the nucleus in various orbits with

الكواكب في الحال هو كما النواة من مسافات مختلفة

varying distances from the nucleus, as is the case of planets

الشمس حول تدور

rotating around the sun.

نموذج النجم الكوكبي يُدعى النموذج هذا لماذا

Q\ Why is Rutherford model called the planetary astral model.

مدارات مختلفة في النواة حول تدور الإلكترونات هذه لأن

Because these electrons rotate around the nucleus in various orbits

الكواكب في الحال هو كما النواة من مسافات مختلفة مع

with varying distances from the nucleus as is the case of planets

الشمس حول تدور

rotating around the sun.

عرف ما يأتي

Q/ Define the following:

البروتون إيجابياً (موجب) مشحون جسيم كتلتها أكبر من

1- **Proton:** a positively charged particle, its mass is greater than

تلك الإلكترون

that of the electron.

الكوكبي النجم نموذج هي رذرفورد نموذج الإلكترونات تدور

2- **planetary astral model:** is Rutherford Model (electrons rotate

حول النواة في مختلفة مدارات مع متفاوتة مسافات من

around the nucleus in various orbits with varying distances from

النواة كما هو حال التي الكواكب تدور حول الشمس

the nucleus as is the case of planets rotating around the sun)

اشرح المشكلة الكوكبي النجم نموذج

Q / Explain the problem of planetary astral model.

راذرفورد نموذج

Rutherford's model.

إذا السالبة الإلكترونات كانت مستقرة

★ If negative electrons are static

رقم 1 فرضية هذه الإلكترونات سوف تُسحب الى الممغنط

No.1 Assumption: these electrons will be drawn to (magnetized) the

للنواة مع موجبة شحنة

nucleus with the positive charge.

إذا الإلكترونات يجب أن تكون في ثابتة حركة

★ If electrons must be in constant motion.

فرضية تفترض بأن المتحركة الإلكترونية الشحنة والتي هي تحت الجاذبية

No.2 Assumption: Given that moving electric charge which is under gravitational

قوة تحرر طاقة لذا هنا يجب ان يكون فقدان في الطاقة المتحرك للإلكترون

force releases energy, so there must be loss in the energy of the moving electron

التى سوف فى النهاية تبطئ حركتها هذا البطئ الإلكترون

which would eventually slow down its motion. This slowing down electron

سوف يتحرك حول في دائرية حركة و أخيرا تسقط في النواة في كِلا

would move around in a circular motion and finally falls into the nucleus. In both

الفرضيتين الذرة يجب ان تنهار

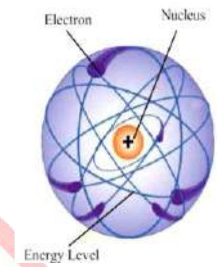
assumptions, the atom must collapse.

نموذج بور

Bohr's Model:

في مقترح بور العالم هو ما

Q\ What is the scientist Bohr propose in (1913)?



طاقة ثابتة في النواة حول تدور الإلكترونات

Electrons rotate around the nucleus in fixed energy

عدد مميز يمتلك مستوى طاقة كل مستويات

levels . Each energy level has a distinctive number

الرئيسي يُدعى العدد هذا طاقتـــه يصف

describing its energy. This number is called principal

عدد الكم

quantum number (n).

مستويات الطاقة ضمن تنتقل الإلكترونات كيف

Q / How do electrons travel within energy levels?

أو اكتساب من خلال مستويات الطاقة ضمن ينتقل ربما الألكترون

An electron may travel within energy levels through gaining or

طاقة فقدان

losing energy.

تمرين

Exercise 1-1

مستوى طاقة عالي يمتلك التالية واحدة أي

Which one of the followings has high energy level?

مستوى طاقة الاول — مستوى طاقة الثاني — مستوى طاقة الثالث

A-First Energy Level **B-Second Energy Level** **C-Third energy level**

عدد الكم الرئيسي عرّف

Q/ Define the principal quantum number.

في مستوى الطاقة الرئيسي يصف عدد : عدد الكم الرئيسي

Principal quantum number: number is describing primary energy level in

الرمز مع الذرة

The atom. With the symbol (n).

ذرة الهيدروجين على يعتمد نموذج بور لماذا

Q\ Why did Bohr's Model base on hydrogen atom?

بروتين واحد تحتوي لأنـــها تركيب ذري ابسط لأنـــها

Because it is the simplest atomic structure, because it contains one proton

الكترون واحد و

and one electron.

تركيب ذري ابسط ذرة الهيدروجين لماذا

Q\ Why is hydrogen atom the simplest atomic structure

الكترون واحد و بروتون واحد تحتوي لأنـــها

Because it contains one proton and one electron.

عرف

Q / Define

النظرية الكمية النظرية الذرية الحديثة

1- Modern atomic theory (quantum theory)

المدار

2- Orbital

فضاء معين في يوجد ربما الإلكترون النظرية الذرية الحديثة

★ **Modern atomic theory:** the electron might exist in a particular space

من قبل اعلن كما أبعاد محددة في ليس و بالنواة يحيط

surrounding the nucleus and not in specific dimensions as stated by Bohr.

الذري هذا بالنواة تحيط غيمة الإلكترون المدار

★ **Orbital:** the electron cloud surrounding the nucleus, This atomic

أحجام و أشكال مختلفة يمتلك المدار

orbital has different shapes and sizes.

للنظرية الحديثة الفرضيات الرئيسية عدد

Q/ List the major hypotheses of the modern theory.

متنوعة مع الإلكترونات بـ محاطة نواة تتضمن الذرات

1. The atoms consist of a nucleus surrounded by electrons with varying

طاقة مستويات

levels of energy.

مستويات الطاقة في مسافة على النواة حول تدور الإلكترونات

2. Electrons rotate around the nucleus on a distance in energy levels.

و بروتونات على تحتوي و الذرة مركز في النواة

3. The nucleus at the center of atom and consists of the protons and

النيوترونات

neutrons.

Exercise 1-2

الغيمة الإلكترونية هي ما

Q\ What is the electron cloud?

والذي النواة حول فضاء خاص هو الغيمة الإلكترونية

Electron cloud: It is a special space surrounding the nucleus in which the

أحجام و أشكال مختلفة يمتلك و يدور فيه الإلكترونات

electrons spin, and it has different shapes and sizes.

الأعداد الكمية الثانوية عرَف

Q / Define the secondary quantum numbers.

التي العلماء من قِبل استخدم عدد عدد الكم الثانوي

Secondary Quantum number: A number used by scientists, which

في الالكترونات هذه وكذلـــــك الاوربتالات صفات جميع الى حد ما تصف

describe fairly all features of the orbital as well as those the electrons in

الاوربتالات هذه

these orbital.

الكم و رمز المستوى الرئيسي مبيناً جدول ارسم

Q / Draw a table showing the main level symbol and the quantum

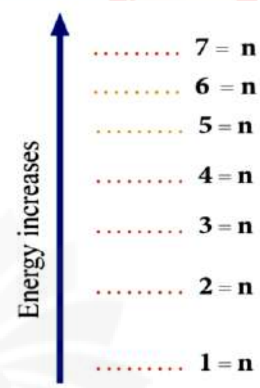
الطاقة ازدياد مبينا" عدد

number showing the increase of energy.

Table 1-1

K	L	M	N	O	P	Q	principal quantum number
1	2	3	4	5	6	7	value of n

Energy ingreasing



قيمة أو قيمة اذا الطاقة العظمى هي ما

Q / what is the most energy if the value of n = 1, or the value of

لماذا و

n = 7, and why?

للإلكترون مسافة ابعد لـ قيمة اعلى

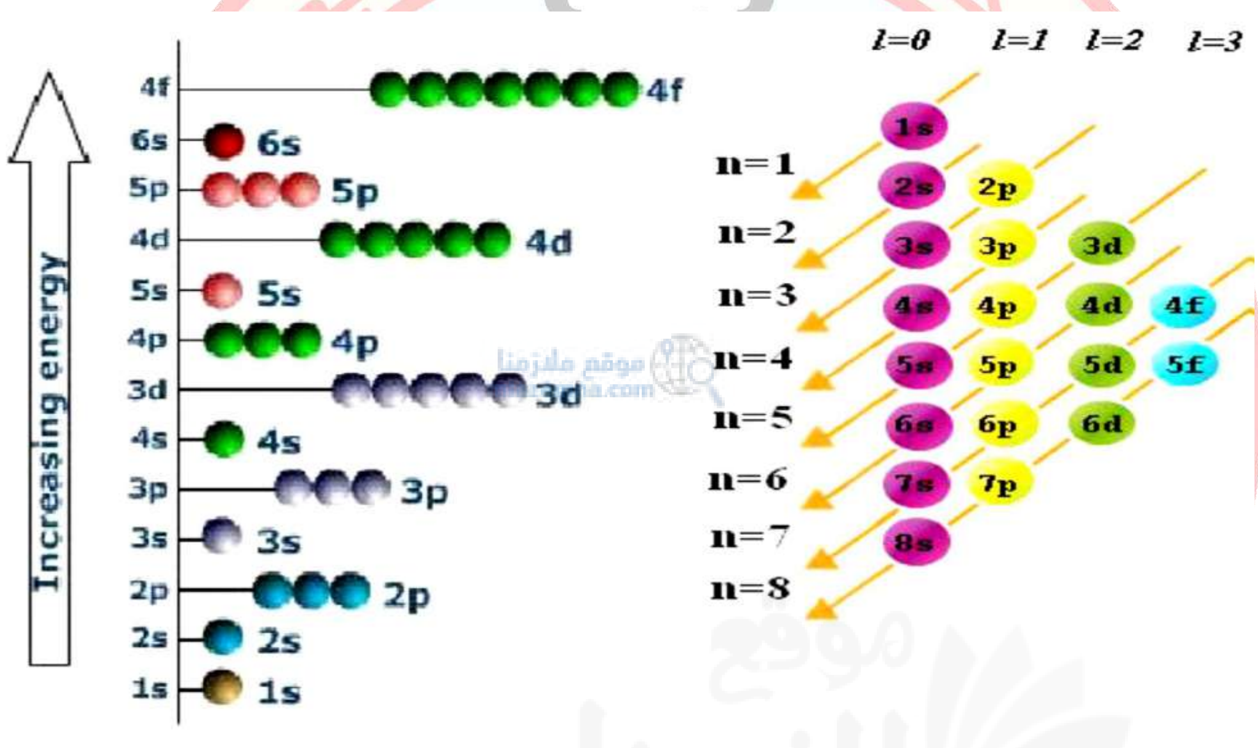
The higher the value of (n), the further the distance of the electron

طاقة اكثر تمتلك بالتتابع فأنها و النواة من

from the nucleus and consequently having more energy.

لماذا يجب الإلكترونات في تكون الأسهل في فقدان الكترونات
Q\ Why should electrons in n = 7 be the easiest to lose of electrons
في
in n = 1.

أقرب هذه المستويات إلى النواة هو يمتلك أوطئ طاقة مستوى
The nearest of these levels to the nucleus is n =1 has the lowest energy level
بينما هي الأبعد من النواة و اقل تماسكا مع النواة
while n =7 is the farthest from the nucleus and less attached to the nucleus,
لذلك هي السهل من أن تُزال
therefore, it is easy to be removed (given away).



عندما قيمة تزداد الطاقة مستوى يزداد
When value of n increases the energy level increases

قارن بين الرئيسي الطاقة و مستوى الرئيسي القوة مستوى
Q / Compare between the main energy level k and the main energy level Q.

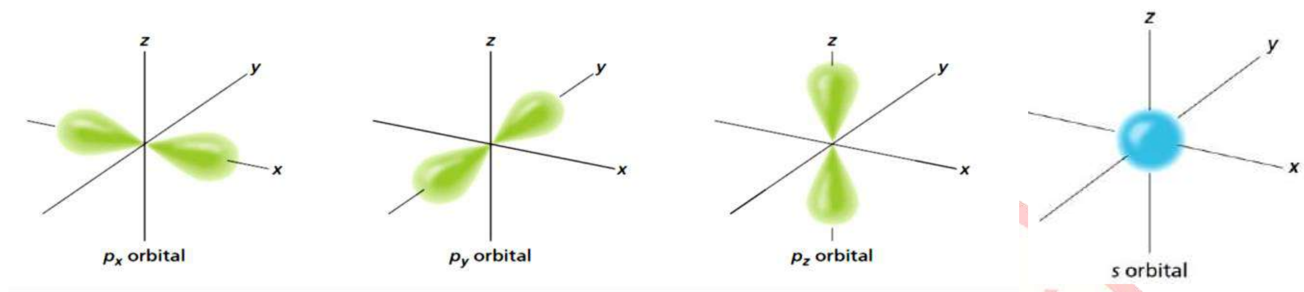
primary energy level k الرئيسي الطاقة مستوى	primary energy level Q الرئيسي القوة مستوى
The value of the quantum no. = 1 قيمة الكمي العدد	The value of the quantum no. = 7 قيمة الكمي العدد
Closer to the nucleus أقرب من النواة	Far from the nucleus بعيدة من النواة
Less Energy اقل طاقة	More energy أكثر طاقة
Electrons in this level are الإلكترونات في هذه مستوى هي more correlated to the nucleus اكثر مرتبطة من النواة	Electrons in this level are less الإلكترونات في هذا المستوى اقل correlated with the nucleus ارتباط مع النواة

Q\ Fill in the blanks:

الرئيسي الطاقة مستويات تمتلك ثانوية طاقة مستويات
1. Primary energy levels (K ,L ,M ,N,..) have secondary energy levels
هذه المستويات تختلف في مصطلحات الشكل و عدد
<u>(s, p, d , and f)</u>. These levels differ in terms of <u>shape</u> and <u>number of</u>
الإلكترونات
<u>electrons.</u>
المدار يمتلك كروي شكل
2. Orbital (s) has a <u>spherical</u> shape.
الثاني المستوى يمتلك ثلاث مدارات و كل مدار يحتوي على
3. The second level (p) it has <u>three orbitals</u> and each orbital consists of
اثنين متطابقين جانبين موزعة في ثلاث عمودية اتجاهات
<u>two equivalent sides</u> distributed in three vertical directions <u>(Pz, Py, Px).</u>
الثانوية المستويات تمتلك اكثر تعقيدا فراغية
4. The secondary levels (d, f), they have more <u>complicated interstitial</u>
الاشكال
forms.

مدارات المستوى الثانوي أشكال الرسم بـ وضح

Q / Illustrate by drawing, forms of secondary level Orbitals S and P



Q\ Fill in the blanks:

نوع مستوى ثانوي واحد فقط يحتوي على المستوى الرئيسي

1. The primary level K contains only one secondary level S type.

و مستويين ثانويين اثنين يمتلك المستوى الرئيسي

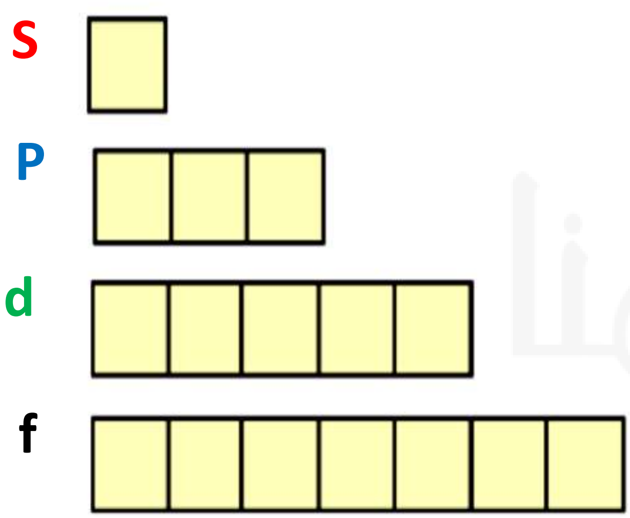
2. The primary level L has two secondary levels, P and S.

و مستويات فرعية ثلاث يمتلك المستوى الرئيسي

3. The primary level M has three sub-levels of d, P and S.

و نوع من مستويات فرعية أربعة يحتوي المستوى الرئيسي

4. The primary level N contains four sub-levels of type f, d, P and S.



هل تعلم

اختيرت الحروف s، p، d، f من الحروف الاولى للمتواليات sharp الحادة و principal الرئيسية و diffuse المنتشرة و fundamental الاساسية وهذه الكلمات تمثل اشكال الخطوط الخاصة بالاطياف الخطية التي ترتبط بانتقالات الطاقة.

مستوى رئيسي اي من المستوى الثانوي اكتب تستطيع كيف

Q / How can you write the secondary level from any major level in

امثلة كافية مع بطريقة رمزية

a symbolic way with sufficient examples?

الخطوات هذه اتبع

Follow these steps

الرئيسي الثالث مثال المستوى الرئيسي من قيمة اكتب

1-Write n value from the primary level, for example, the third primary

المستوى او

level or M

يمين للمستوى الثانوي المعين الرمز اكتب

2 - Write the character assigned to the secondary level right to the

مثال قيمة

value of n, for example:

هو للمستوى الرئيسي الثالث المستوى الثانوي الاول

The first secondary level (S) of the third main level is: ((3S))

المستوى الرئيسي الرابع من المستوى الثانوي ثالث اكتب مثال

Example 1: write the third secondary level d from the fourth primary level

بعدها الحرف اكتب و المستوى الرئيسي الرابع اكتب

Sol: Write the fourth primary level ((n = 4)) and write a letter d after it (4 d)

المستوى الرئيسي الثاني من المستوى الثانوي الثاني اكتب مثال

Example 2: write the second secondary level p from the second primary level

الحل مباشرة"

Direct Solution: 2p

للمستوى الرئيسي الخامس المستوى الثانوي الرابع اكتب مثال

Example 3: Type the fourth secondary level of the fifth main level

يعني المستوى الرئيسي الخامس الحل

Solution: The fifth main level means n = 5

Sol: 5f

هو المستوى الثانوي الرابع

The fourth secondary level is f

كن أو لا تكون



Exercise 1-3

الطاقة الرئيسي الثالث و الأول المدار عدد هو ما

Q\ What is the number of orbital of the first and the third primary energy

المستوى

level?

يساوي لمستوى الطاقة الأول المدار عدد

*** Number of orbital of first energy level equal 1**

مستوى طاقة ثانوي واحد فقط مستوى هذا في السبب

Because: in this level only one secondary energy level (s)

يساوي مستوى الطاقة الثالث المدار عدد

**** number of orbital of third energy level equal 9**

مستوى الطاقة الثانوي الثالث مستوى هذا في السبب

Because: in this level three secondary energy level (s , p , d)

Q\ Fill in the blanks:

مدار واحد يمتلك المستوى الثانوي

1. Secondary level s, has 1 Orbital.

مدارات ثلاث يمتلك المستوى الثانوي

2. Secondary level p has 3 Orbitals.

مدارات خمس يمتلك المستوى الثانوي

3. Secondary level d has 5 Orbitals.

مدارات سبع يمتلك المستوى الثانوي

4. Secondary level f has 7 Orbitals.

الكترونات اثنان فقط المدار لاستيعاب الحد الأعلى

5. The maximum capacity of the orbital only two electrons.

مربع برسم الطاقة الثانوي مستوى في رمز المدار

6. Orbital symbol in the level of secondary energy by drawing square

الكترونات كحد أعلى مملوءة المستوى الثانوي

7. The secondary level s is filled with a maximum of 2 electrons.

الكترونات كحد أعلى مملوءة المستوى الثانوي

8. The secondary level p is filled with a maximum of 6 electrons.

الكترونات كحد أعلى مملوءة المستوى الثانوي

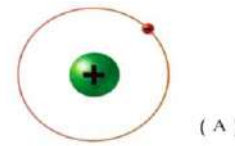
9. The secondary level d is filled with a maximum of 10 electrons.

الكترونات كحد أعلى مملوءة المستوى الثانوي

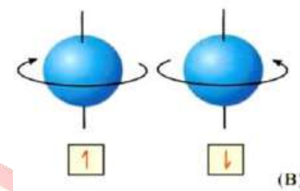
10. The secondary level f is filled with a maximum of 14 electrons.

احتمال إلي باللون الأخضر هو الفراغ
احتمال إلي باللون الأحمر هو الفراغ

Spin of electron



يدور الإلكترون حول النواة
A) Turn of electron around of nucleus.
يدور نفس المدار و المحور الخاص للإلكترون
B) Turn the same orbital and own axis of electron



كيف ترسم الإلكترونات ضمن الواحد المدار
Q / How do you draw electrons within the single orbit?

يبرم مع عقرب الساعة
1. spin clock wise
عكس عقرب الساعة
2. Anti-clock wise
مدار مزدوج الكترون مشبع
3. Orbital double electron (saturated)

Solution:

باتجاه عقرب الساعة
1. spin clock wise. — ↿ — الأعلى من الرأس Head from top
يدور عكس عقرب الساعة
2. spin anti-clock wise. — ⇂ — أسفل الرأس Head down
اوربتال مزدوج الإلكترون مشبعة
3. Orbital double electron (saturated). — ⇅ — بالعكس In reverse

حفظها مثل اسمك

اس اس بس بس

122334

1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s



Notes

عدد المدارات في كل ثانوي مستوى هو فردي عدد
1 - The number of Orbitals in each secondary level is an odd number 1-3-5-7.
عدد الألكترونات التي تشبع و هو زوجي عدد
2. The number of electrons that saturate d, p, and s is an even number 2-6-10-14.

المدار نفس في الأخر احدهما تتنافر لا الإلكترونات لماذا

Why\ the electrons don't repel each other in same orbital.

حول يبرم كما الوقت نفسه في نفسه حول يدور الكترون كل

النواة

Each electron spins around itself at the same time as it spins around the nucleus.

الترتيب الإلكتروني عرَف

Q / Define Electronic Configuration:

حول يأخذ الإلكترونات الذي النظام الترتيب الإلكتروني

ترتيب إلكتروني خاص يمتلك عنصر كل و الذرة في النواة

Electron Configuration: The order in which the electrons take around the nucleus in the atom and each element has a special electronic arrangement.

الترتيب الإلكتروني مبادئ اوفباو عرًف

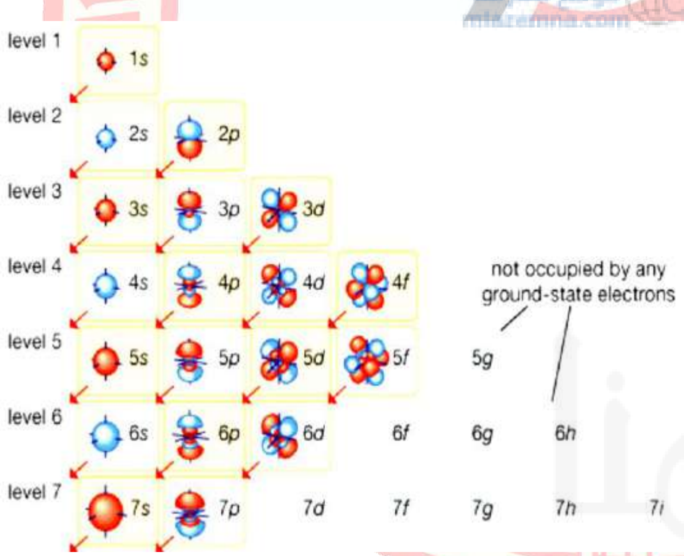
Q / Define : Aufbau Principles of Electron Configuration.

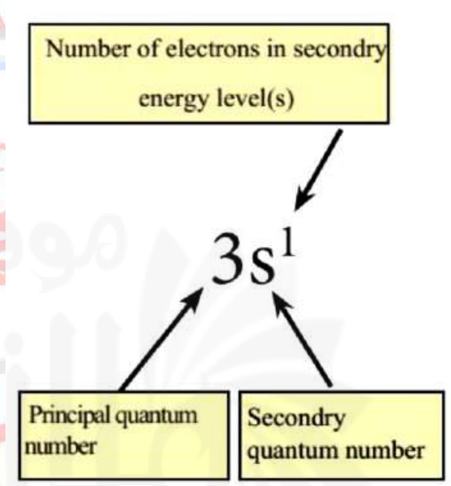
important

وفقاً" لـــ بالإلكترونات ممتلئة مستويات الطاقة الثانوية كل

الأعلى الى الأسفل من بالتتابع طاقتها

(All secondary energy levels are filled with electrons according to their energy sequence from bottom to top)





قاعدة هوند

Q / Define : Hund's rule .

الثانوي في تحتل بشكل مضاعف الكترونين لا يوجد

تملئ بشكل مفرد الاوربيتالاتـــــها مالم

Hund's rule: No two electrons are doubly occupied in the subshell (secondary level) unless its orbitals are singly filled

important

Example 1-1:

المستوى الثانوي التالي الترتيب الإلكتروني اكتب

Write the electronic configuration for the following subshells?

p^3, d^4, f^6, p^4, d^7, f^{11}, p^5

p^3	[↑][↑][↑]
d^4	[↑][↑][↑][↑][ ]
f^6	[↑][↑][↑][↑][↑][↑][ ]
p^4	[↑↓][↑][↑]
d^7	[↑↓][↑↓][↑][↑][↑]
f^{11}	[↑↓][↑↓][↑↓][↑↓][↑][↑][↑]
p^5	[↑↓][↑↓][↑]

Exercise 1-4

للمستوى الفرعي التالي الترتيب الإلكتروني اكتب

Write the electronic configuration for the following subshell:

p^2, d^6, d^3, p^5

p^2	[↑][↑][ ]
d^6	[↑↓][↑][↑][↑][↑]
p^5	[↑↓][↑↓][↑]
d^3	[↑][↑][↑][ ][ ]

Example 1-2

للعناصر التالية الترتيب الإلكتروني اكتب

Write the electronic configuration for the following elements:

$_4Be$, $_3Li$, $_2He$, $_1H$

Element	electronic configuration
$_1H$	$1s^1$
$_2He$	$1s^2$
$_3Li$	$1s^2$ $2s^1$
$_4Be$	$1s^2$ $2s^2$

Example 1-3

اكتب الإلكتروني الترتيب ونظام الإلكترونات في

Write the electronic configuration and order of electrons in the

الخارجي الطاقة مستوى لكل من التالية للعناصر

Outermost energy level for each of the following elements:

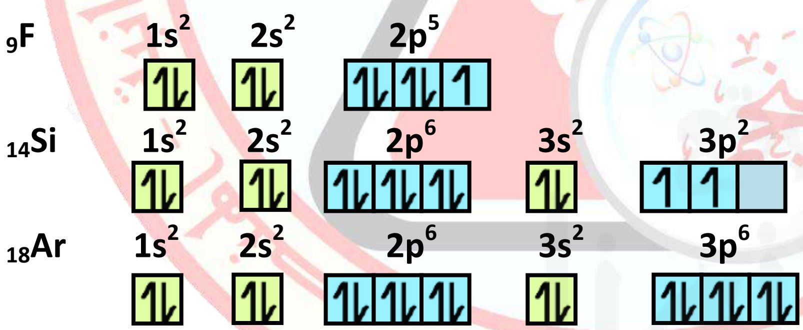
$_{15}P$, $_{13}Al$, $_{12}Mg$, $_{10}Ne$, $_{8}O$, $_{5}B$

Element	electron configuration	outermost energy level
$_{5}B$	$1s^2\ 2s^2\ 2p^1$	$2s^2\ 2p^1$
$_{8}O$	$1s^2\ 2s^2\ 2p^4$	$2s^2\ 2p^4$
$_{10}Ne$	$1s^2\ 2s^2\ 2p^6$	$2s^2\ 2p^6$
$_{12}Mg$	$1s^2\ 2s^2\ 2p^6\ 3s^2$	$3s^2$
$_{13}Al$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$	$3s^2\ 3p^1$
$_{15}P$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	$3s^2\ 3p^3$

Exercise 1-5

اكتب الإلكتروني الترتيب التالية للعناصر

Write the electronic configuration for the following elements.



عرف التكافؤ الكترونات

Q\ define: Valence electrons

هي الإلكترونات في الأخير الرئيسي الطاقة مستوى التي

Valence electrons: Are the electrons in the last primary energy level that

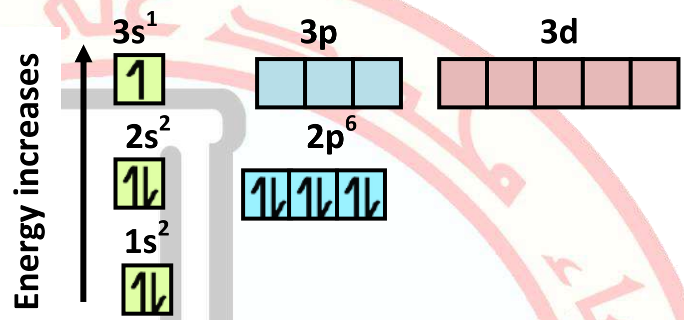
تحديد الفيزيائية و الكيميائية الخواص لـ عنصر

determine the physical and chemical properties of the element

Example 1-4

بيّن ثم لذرة الصوديوم الترتيب الإلكتروني اكتب
Write the electronic configuration of sodium atom Na then, indicate
مستويات الطاقة رئيسي لـ وفقاً الطاقة تدرج
the gradual energy according to the primary energy levels.

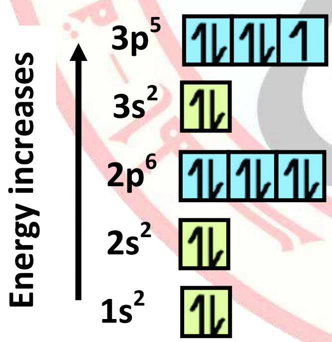
$_{11}Na$ $1s^2$ $2s^2$ $2p^6$ $3s^1$



Example 1-5

بيّن ثم للكلور الترتيب الإلكتروني اكتب
Write the electronic configuration of chlorine $_{17}Cl$ then indicate the
الأعلى الى الأسفل من مستويات الطاقة الثانوية ترتيب
order of secondary energy levels from lowest to the highest.

$_{17}Cl$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$



انتبه على كلمة primary أو principal أو secondary كما في الأمثلة أعلاه

ملاحظة
مطلوب منك معرفة العناصر التي لا يتجاوز عددها الذري 20 من الجدول الدوري

✱ It is important that the student know only the Atomic number for the first (20) elements from the periodic table to solve the chapter questions.

Exercise 1-6

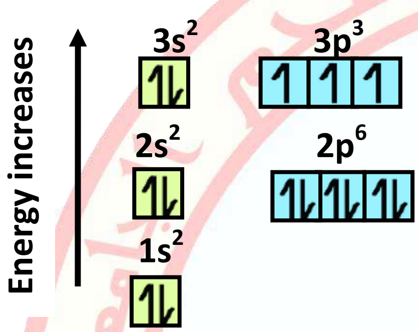
بيِّن ثم للذرات التالية الترتيب الإلكتروني اكتب

Write the electronic configuration for the following atoms then indicate

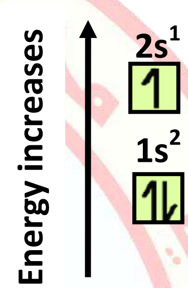
مستويات الطاقة الرئيسي لـ وفقا" الطاقة تدرج

the gradual energy according to the primary energy levels. $_{15}P$, $_{3}Li$

$_{15}P$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^3$



$_{3}Li$ $1s^2$ $2s^1$



Exercise 1-7

ثم للذرات التالية الترتيب الألكتروني اكتب

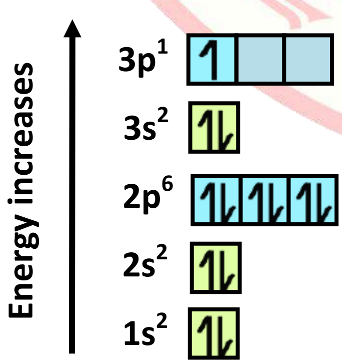
Write the electronic configuration for the following atoms then

لمستويات الطاقة الثانوي لـ وفقا" الطاقة تدرج بيَن

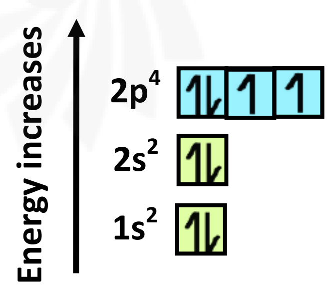
indicate the gradual energy according to the secondary energy levels.

$_{13}A1$, $_{8}O$

$_{13}Al$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^1$



$_{8}O$ $1s^2$ $2s^2$ $2P^4$



Example 1-6

حول مستوى طاقة رئيسي كل في الإلكترونات عدد وضح
State the number of electrons in each primary energy level around the
النواة
nucleus. $_{5}B$, $_{10}Ne$, $_{12}Mg$

Solution:

$_{5}B$: $1S^{2}$ $2S^{2}$ $2p^{1}$

الأول الرئيسي المستوى يحتوي الكترونين
First primary level n=1 contains 2 electrons.
الثاني الرئيسي المستوى تحتوي الكترونات
Second Primary level n=2 contains 3 electrons.

1S يمثل المستوى الرئيسي الأول
2S 2p يمثل المستوى الرئيسي الثاني

$_{10}Ne$ $1s^{2}$,$2s^{2}$ $2p^{6}$
الأول الرئيسي المستوى يحتوي الكترونين
First primary level n=l contains 2 electrons.
الثاني الرئيسي المستوى يحتوي الكترونات
Second primary level n=2 contains 8 electrons.

$_{12}Mg$ $1s^{2}$ $2s^{2}$ $2p^{6}$ $3s^{2}$
الأول الرئيسي المستوى يحتوي الكترونين
First primary level n=l contains 2 electrons.
الثاني الرئيسي المستوى يحتوي الكترونات
Second primary level n=2 contains 8 electrons.
الثالث الرئيسي المستوى يحتوي الكترونين
Third primary level n=3 contains 2 electrons.

1S يمثل المستوى الرئيسي الأول
2S 2p يمثل المستوى الرئيسي الثاني
3S يمثل المستوى الرئيسي الثالث

Exercise 1-8 H.W

What is the number of electrons in each primary energy level for these elements $_{2}He$, $_{7}N$

ماذا رمز لويس يعتمد على

Q / What does Lewis symbol depend on?

يعتمد على عدد الإلكترونات في المستوى الأخير مستوى التكافؤ

It depends on the number of electrons at the last shell (valence shell)

او مستوى الطاقة الأخير

or the last energy level.

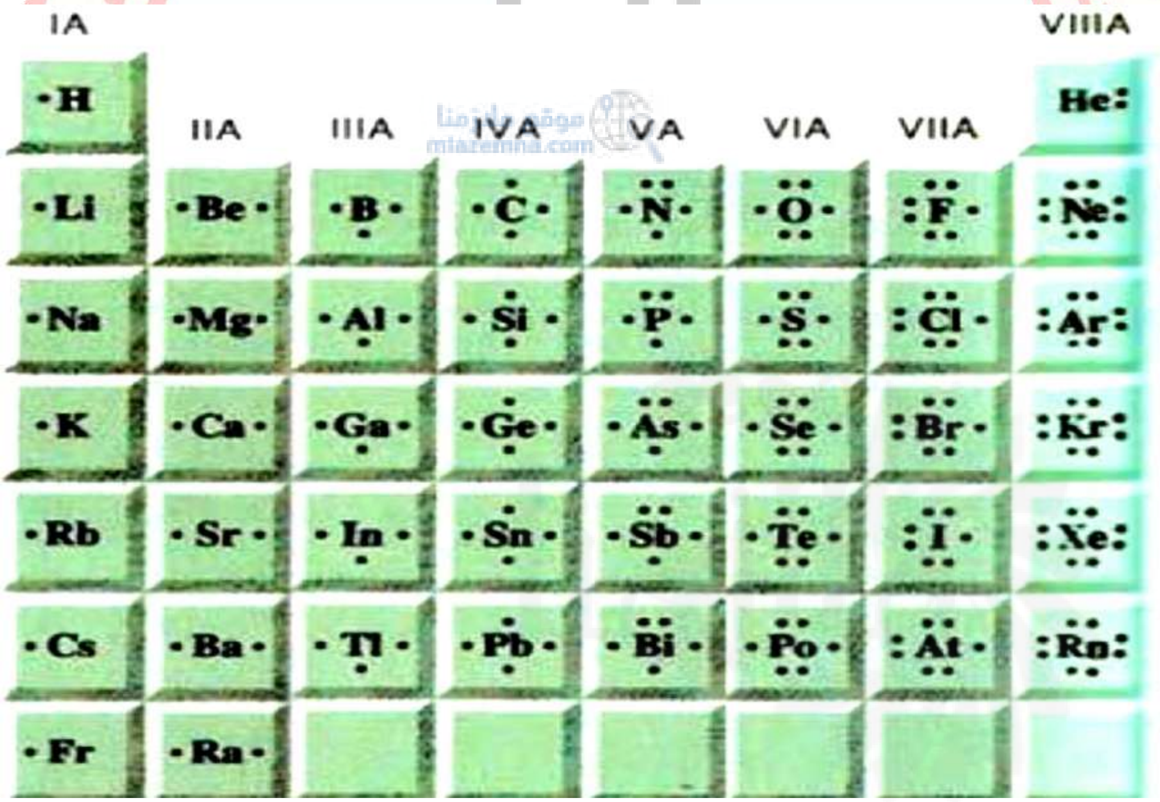
***** لكتابة رمز لويس نتبع الخطوات التالية:**

1- نكتب الترتيب الإلكتروني للعنصر المراد معرفة رمز لويس لهُ.

2- تحديد عدد الإلكترونات في مستوى الطاقة الخارجي .

3- ترسم حوله نقاط، كل نقطة تمثل الكترون واحد في غلاف التكافؤ الخارجي كما في الشكل أدناه:

رمز لويس مثال : Si Ar



Example 1-7

اكتب لويس رمز للتالي

Write Lewis symbol for the following : $_{12}Mg$, $_{10}Ne$, $_{5}B$, $_{1}H$

Element	Electron configuration	Electron in the outer Level energy	Lewis symbol
$_{1}H$	$1s^1$	1	H•
$_{5}B$	$1s^2\ 2s^2\ 2p^1$	3	•B• with one dot above (3 dots)
$_{10}Ne$	$1s^2\ 2s^2\ 2p^6$	8	Ne with 8 dots
$_{12}Mg$	$1s^2\ 2s^2\ 2p^6\ 3s^2$	2	•Mg•
$_{14}Si$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$	4	Si with 4 dots

Exercise 1-8

اكتب لويس رمز التالية للعناصر

Write Lewis symbol of the following elements: $_{13}Al$, $_{18}Ar$ $_{20}Ca$

Element	Electronic configuration	Electron in the outer Level energy	Lewis symbol
$_{13}Al$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$	3	•Al• with one dot below (3 dots)
$_{18}Ar$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	8	Ar with 8 dots
$_{20}Ca$	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	2	•Ca•

Example 1-8

التالي ك مرتبة إلكتروناتها ذرة

An atom, the electrons of which are ordered as follows.

$1s^2\ 2s^2\ 2p^4$.

الذرة هذه في الإلكترونات عدد الكلي هو ما

1- What is the total number of electrons in this atom?

العدد الذري هو العدد

2- What is the atomic number?

بالإلكترونات مملوء لمستوى الطاقة الثانوي عدد ما

3- How many secondary energy level filled with electrons?

الالكترون المنفرد عدد هو ما

4- What is the number of single electron?

الذرة هذه رمز لويس اكتب

5- Write Lewis symbol for this atom?

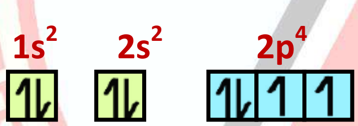
Solution:

الإلكترونات عدد

1-The number of electrons are 8.

الألكترونات عدد مساويا" لأنها العدد الذرى

2-The atomic number is 8 because it equals to the number of electrons.



مملوء ليس هو كما بالكترونات محتل المستوى الثانوي

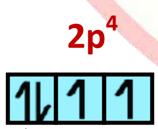
3 -The secondary level 1s and 2s are occupied by electrons as for 2p it is not filled

اثنين فقط هو بالإلكترونات ملئ المستويات الثانوية عدد

,so the number of secondary levels filled with electrons is only two.

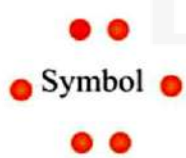
فقط اثنين هو الإلكترونات غير مزدوجة عدد بأن لوحظ

4-It is noted that the number of unpaired electrons are two only.



هو رمز لويس

5- Lewis symbol is



Exercise 1-10

H.W

If atomic number of element is 6 :

1- Write its electronic configuration

2- How many secondary energy level filled with electrons?

3- What is the number of single electron?

4- Write Lewis symbol for this atom.

أداة أهمية أكثر يُعتبر الجدول الدوري لماذا

Q\ Why is the periodic table considered the most important tool for

الكيمياء يدرسون الذين

those who study chemistry.

و الفيزيائية العناصر خصائص فهم و تنبؤ في مفيدة

It is useful in predicting and understanding properties of elements (physical and

للعنصر الخصائص الكيميائية

chemical properties of an element)

الفيزيائية الخصائص يحدد الإلكترونات ماهي

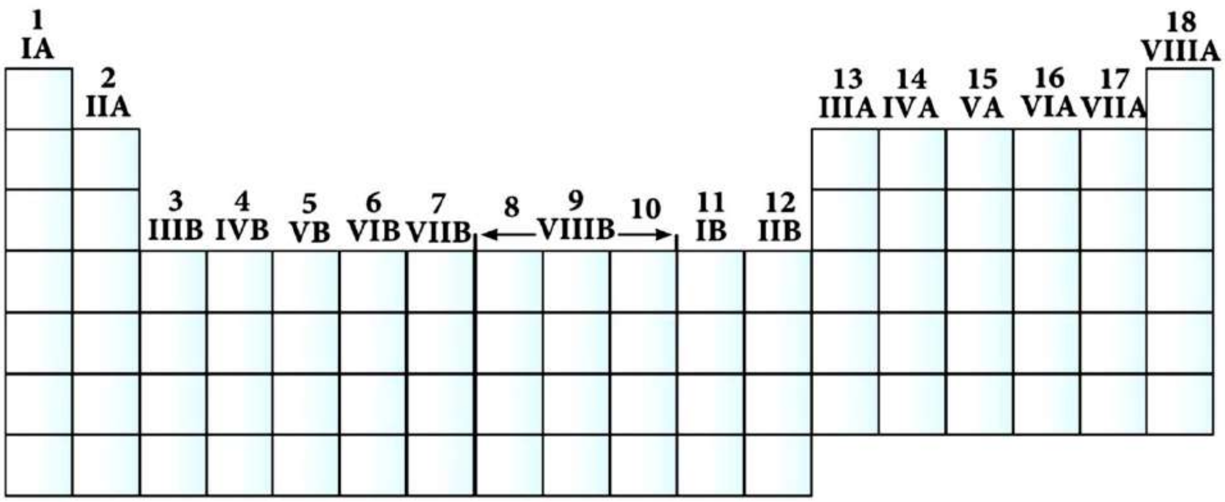
Q\ Which electrons do they determine the properties of the physical

للعنصر الكيميائية

and chemical element?

مستوى الطاقة الخارجي في موجود الإلكترونات المتكافئة

Equivalent electrons exist in external energy levels.



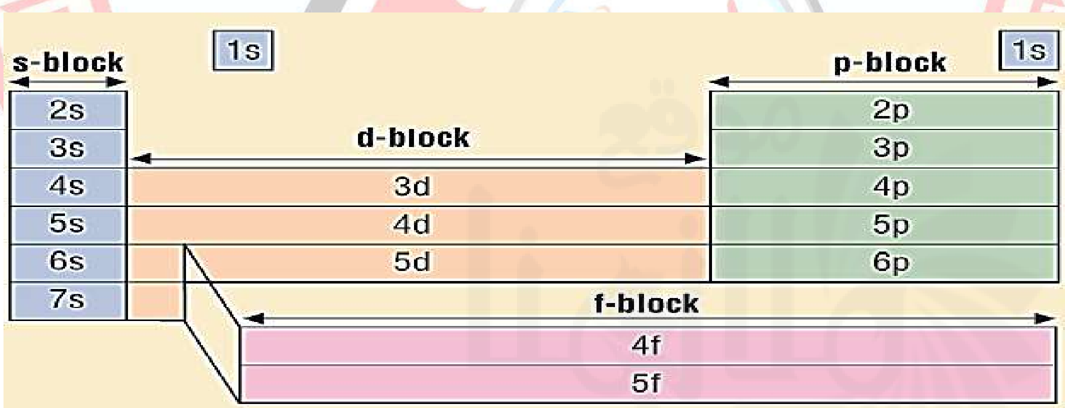
نلاحظ في الجدول الدوري أعلاه ان الجدول مكون من مجموعتين A and B

المستوى الثانوي مبينا" للجدول الدوري شكل ارسم

Q\Draw a form for the periodic table showing the secondary level

مجاميع

blocks s, p, d, f.



عناصر المجموعة عرف

Q \ define s- Block Elements.

الزمر متضمن الجدول الدوري يسار اقصى على العناصر هي

They are elements on the far left of the periodic table including groups IA

هيليوم عـدا بـ ينتهي ترتيبها الإلكتروني التي و

and IIA, whose electronic configuration ends with s, except for helium (He).

املأ الفراغات
Q\ fill in the blanks.

واحد تمتلك مستويات الطاقة الثانوي الأخير التي العناصر تتضمن الزمرة
1- Group IA includes elements whose last secondary energy level s, have one
الكترون
electron.

يمتلك مستوى الطاقة الثانوي الأخير التي العناصر تتضمن الزمرة
2- group IIA, it includes elements whose last secondary energy level have
اثنين الكترونين
two electrons.

عرف المجموعة عناصر
Q \ define p- Block Elements.

الإلكتروني التي الجدول الدوري الجانب الأيمن على يقع العناصر
Elements are located on the right side of the periodic table, whose electronic
زمر ست تتضمن و بـ تنتهي ترتيبها
configuration ends with p and include six groups.

الصفر زمرة أو زمرة عرف
Q \ define (group VIIIA or group zero).

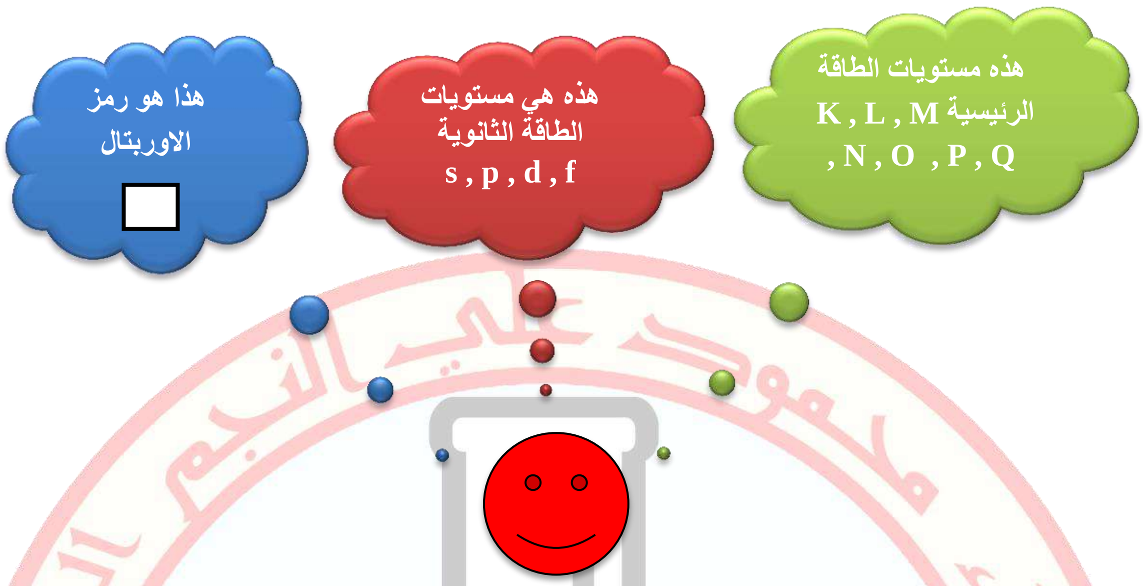
الغازات النبيلة تدعى الجدول الدوري من اليمين الأقصى على الزمرة الأخيرة
last group on the far right of the periodic table, it is called the noble gases
المستويات الثانوية في بإلكترونات مملوء "جزئيا" العناصر هذه زمرة
group. These Elements partly filled with electrons at the secondary shells s
العناصر ممثلة تدعى العناصر النبيلة و و
and p, and noble elements are called (represented elements)

عرِّف المجموعة عناصر
Q \ define d- Block Elements.

بـ تنتهي ترتيبها الإلكتروني التي عناصر الفلزية هي
These are metal elements whose electronic configuration ends with s and
مركز في عناصر المجموعة أو العناصر الانتقالية تدعى هي
d, they are called transition elements or d- block elements, at the center of
الجدول الدوري
the periodic table.

عرف المجموعة عناصر
Q \ define f- Block Elements.

التي الجدول الدوري أسفل في تقع العناصر هذه
These elements are located at the bottom of the periodic table whose
الانتقالية الداخلية تدعى و بـ ينتهي الترتيب الإلكتروني
electronic configuration ends with f , and called the inner transition
الدورة السابعة و السادسة الى تنتمي زمرة تتضمن عناصر
elements, including 14 groups belonging to sixth and seventh periods.



سبب أعطِ

Q\ Give a reason

مجموعة أو زمرة تدعى الزمرتين الثانية و الأولى لماذا

1- Why are the first and second groups called the group "s" or block "s"?

مستوى الطاقة الثانوي عند ينتهي ترتيبها الإلكتروني لأن

Answer: Because it's electronic order ends at secondary energy level s.

أو المجموعة عناصر تدعى الزمرة

2- Why is The group (3, 4,5,6,7,8) called the elements of the group "p" or

تجمع

the block "p".

مستوى الطاقة الثانوي عند ينتهي ترتيبها الإلكتروني لأن

Answer: Because it's electronic order ends at the secondary energy level "p".

التجمع إلى ترجع العناصر الانتقالية

3 - The transition elements belong to the Block "d".

التجمع تدعى العناصر الانتقالية

The transitional elements were called the block "d".

مستوى الطاقة الثانوي عند ينتهي ترتيبها الإلكتروني لأن

Answer: Because its electronic order ends at the secondary energy level "d"

تجمع تدعى العناصر الانتقالية

4 - The transitional elements are called the block "f".

مستوى الطاقة الثانوى بـ ينتهى ترتيبها الإلكترونى لأن

sol: Because it's electronic configuration ends with secondary energy level "f".

هيليوم عنصر مجموعة بالرغم من وجودها في

5 - Helium is a element of the block "s" in spite of its presence in the block "p".

لأن الإلكتروني ترتيبها يـنتهي بـ الثانوي الطاقة مستوى

sol: Because it's electronic configuration ends with secondary energy level "s"

س / كيف يتم معرفة رقم الزمرة والدورة لأي عنصر من عناصر المجموعة A .

لمعرفة الزمرة والدورة نكتب الترتيب الإلكتروني للعنصر ثم نتبع الخطوات :

1- لمعرفة الدورة : يمكن معرفة الدورة من قيمة n الموجودة قبل المستوى الثانوي الأخير مثلاً :

$_{7}N$ $1s^2$ $2s^2$ $2p^3$ النيتروجين يقع في الدورة الثانية

$_{12}Mg$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ المغنيسيوم يقع في الدورة الثالثة

2- لمعرفة الزمرة : يوجد احتماليين هما :

أ – اذا انتهى الترتيب الإلكتروني بالمستوى s فأن العدد الموجود اعلى المستوى s هو رقم الزمرة مثلاً :

$_{3}Li$ $1s^2$ $2s^1$ الليثيوم يقع في الزمرة الأولى

$_{20}Ca$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$ الكالسيوم يقع في الزمرة الثانية

ب - اذا انتهى الرتيب الإلكتروني بالمستوى p فأن العدد الموجود اعلى المستوى p + العدد الموجود اعلى المستوى s الذي يقع قبله هو رقم الزمرة مثلاً:

$_{15}P$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^3$ $5 = 2 + 3$ الفسفور يقع في الزمرة الخامسة

$_{9}F$ $1s^2$ $2s^2$ $2p^5$ $7 = 2 + 5$ الفلور يقع في الزمرة السابعة

يحتوي تجمع كل التي الزمر عدد هو ما

Q / What is the number of groups that each block contains: s, p, d, f

1- S → 2 groups
2 - P → 6 groups
3- d → 10 groups
4- f → 14 groups

اذا انتهى الترتيب الإلكتروني بـ:
المستوى الثانوي S فأن الكترونات S هي التي تمثل الزمرة
المستوى الثانوي P فأن الكترونات P و S هي التي تمثل الزمرة

عدد الزمر في كل بلوك يساوي عدد الإلكترونات المشبعة للمستوى الثانوي

Example 1-9

ما هي الدورة و الزمرة التالية العناصر
What are the period and group for the following elements:

$_{19}K$, $_{10}Ne$, $_{17}Cl$, $_8O$:

$_8O$ $1s^2$ $2s^2$ $2p^4$

الأوكسجين يقع الثانية الدورة و السادسة الزمرة
Oxygen is located in the second period and the sixth group.

$_{17}Cl$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$

الكلور يقع في الثالثة الدورة و السابعة الزمرة
Chlorine located in the third period and the seventh group.

$_{10}Ne$ $1s^2$ $2s^2$ $2p^6$

نيون يقع في الثانية الدورة و الثامنة الزمرة
Neon is located in the second period and eighth group.

$_{19}K$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^1$

البوتاسيوم يقع في الرابعة الدورة الأولى الزمرة
Potassium is located in the fourth period and the first group.

Example 1-10

ما هي المشتركة الخاصية بين مواقع التالية
What is the common property between the locations of the following
العناصر في الدوري الجدول
elements in the periodic table?

$_{12}Mg$, $_{11}Na$, $_3Li$

Solution:

$_3Li$: $1s^2$ $2s^1$ group (1A) / 2nd period.

$_{11}Na$ $1s^2$ $2s^2$ $2p^6$ $3s^1$ group (1A) / 3rd period.

$_{12}Mg$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ group (2A) / 3rd period.

"وفقا للمذكور اعلاه المشتركة الخاصية بين و بأنه
According to the above, the common property between Li and Na is that they
كلاهما يمتلكان نفس الزمرة
both have the same group (Group 1A).

المشتركة الخاصية بين هما يمتلكان نفس الدورة
The common property between Na and Mg is that they have the same period
الثالثة الدورة
3rd period.

Example 1-11

هي المشتركة الخاصية بين مواقع التالية العناصر
What is the common property between the locations of the following elements
في الدوري الجدول
in the periodic table? $_4Be$,$_5B$, $_7N$

Solution:

$_4Be$ $1s^2\ 2s^2$ group (2A) / 2nd period

$_5B$ $1s^2\ 2s^2\ 2p^1$ group (3A) / 2nd period

$_7N$ $1s^2\ 2s^2\ 2p^3$ group (5A) / 2nd period

كل هذه العناصر في نفس الدورة الثانية الدورة
All these elements are in the same period 2nd period.
تختلف من واحدة لأخرى مع مراعاة الزمر
They differ from each other with respect to groups.
كل عنصر يرجع مختلفة زمرة
Each element belongs to a different group.
بريليوم في الثانية الزمرة بارون في الثالثة الزمرة و نتروجين
Beryllium (Be) is in the second group, Boron (B) in the third group and Nitrogen
في الخامسة الزمرة
(N) in the fifth group.

Exercise 1- 11

ما هي الدورة و الزمرة التالية العناصر
What are the period and group for the following elements:

$_{19}K$, $_{10}Ne$, $_{17}Cl$, $_8O$:

Exercise 1- 12

التالية مواقع بين الخاصية المشتركة هي ما
What is the common property between the locations of the following
الجدول الدوري في العناصر
elements in the periodic table? $_{15}P$, $_{14}Si$, $_{6}C$

Solution:

$_{15}P$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 2p^3$ group (5A) / 3rd period

$_{14}Si$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 2p^2$ group (4A) / 3rd period

$_{6}C$ $1s^2\ 2s^2\ 2p^2$ group (4A) / 2nd period

الدورة الثانية الدورة نفس في العناصر
P and Si elements are in the same period 2nd period.

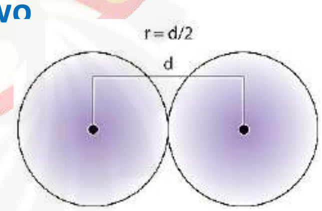
C and Si elements are in the same group fourth group.

نصف قطر الذرة عرف
Q\ define Atomic Radius

مرتبطة كيميائيا و متطابقة بين المسافة نصف قطر الذرة
Atomic Radius: The distance between the identical and chemically combined
ذرتين نواة
nucleus of two atoms.

الذرة نصف قطر تحسب تستطيع كيف
Q / How can you calculate the radius of the atom?

مرتبطة كيميائيا و متجانسة بين المسافة بحساب
by calculating the distance between the identical and chemically combined
اثنين الناتج تقسيم ثم و ذرتين نواة
nucleus of two atoms and then divide the outcome by two



or

اثنين بين للمسافة الحد الأدنى نصف
"Half of the minimum distance between two
العنصر نوى مرتبطة كيميائيا و متطابقة
identical and chemically-combined nuclei of the element."

خطوات حل أسئلة نصف القطر:

1- كتابة الترتيب الإلكتروني لكل عنصر مطلوب
2- استخراج رقم الزمرة والدورة لكل عنصر مطلوب
3- تحديد نوع الاشتراك للعناصر أن كان في الزمرة أو الدورة
- إذا كان الاشتراك ضمن الزمرة فيكون الأكبر عدد ذري هو الأكبر نصف قطر
- إذا كان الاشتراك ضمن الدورة فيكون الأكبر عدد ذري هو الأصغر نصف قطر

نحن عندما يقل الدورة الواحدة في العناصر نصف قطر لماذا
Q\ Why does the radius of the elements in one period decrease as we move from left to right (in period table)
ننتقل من اليسار إلى اليمين في الجدول الدوري

و المستوى الرئيسي الواحد ضمن الإلكترونات بين طاقة الجذب
The attraction energy between the electrons within one main level and the positive charge of the nucleus increases with increasing in the number of electrons in it.
الموجبة الشحنة النواة تزداد مع زيادة في عدد الإلكترونات فيها

Example 1-12

الذري في ازدياد لـ وفقاً" للعناصر التالية رتب
Arrange the following elements according to increasing in their atomic radius. $_9F$, $_6C$, $_8O$, $_3Li$
نصف القطر

$_3Li$ $1s^2$ $2s^1$
$_8O$ $1s^2$ $2s^2$ $2p^4$
$_6C$ $1s^2$ $2s^2$ $2p^2$
$_9F$ $1s^2$ $2s^2$ $2p^5$

الاشتراك ضمن الدورة	الاشتراك ضمن الزمرة
الأكبر عدد ذري هو الأصغر نق	الأكبر عدد ذري هو الأكبر نق

Notice that all the elements above end with the second main level. This Means that they are all in second period of the periodic table. Thus, the arrangement of these elements according to the increase in their radius is as follow:
يعني هذا المستوى الرئيسي الثاني مع تنتهي المذكورة العناصر كل بأن نلاحظ ترتيب لذا للجدول الدوري الدورة الثانية في كلها بأن كالتالي هي نصف قطرها ازدياد لـ وفقاً العناصر هذه

$$_3Li > _6C > _8O > _9F$$

Exercises 1-13

رتب التالية العناصر وفقاً الى زيادة في
Arrange the following elements according to the increase in their
الذري نصف قطرها
atomic radius $_{20}Ca$, $_{12}Mg$, $_{4}Be$

$_{4}Be$ $1s^2$ $2s^2$

$_{12}Mg$ $1s^2$ $2s^2$ $2p^6$ $3s^2$

$_{20}Ca$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$

يلاحظ بأن كل العناصر أعلاه تنتهي مع الثاني الرئيسي مستوى هذا يعني
Notice that all the elements above end with the second main level. This Means
بأن كلها في الثانية الزمرة الدوري للجدول لذا ترتيب
that they are all in second group of the periodic table. Thus, the arrangement of
هذه العناصر وفقاً لـ ازدياد نصف قطرها هي كالتالي
these elements according to the increase in their radius is as follow:

$_{20}Ca$ > $_{12}Mg$ > $_{4}Be$

لماذا نصف القطر الذرة يزداد بزيادة الذري
Q\ Why does the radius of atom increase by increasing the atomic
العدد ضمن الواحدة الزمرة
number within a single group?

الجواب الإلكترونات تتحرك بعيدا من النواة
Answer: the electrons move away from the nucleus.

عرف التأين طاقة
Q\ Define Ionization Energy

التاين طاقة كمية الطاقة المطلوبة لـ إزالة واحد الكترون
Ionization Energy: The amount of energy required to remove one electron
من الخارجي الطاقة لـ مستوى الغازية الذرة
from the outer energy level of a gaseous atom.

Na + ionization energy → Na^+

كلما تزداد الدورات في الطاقات الأيونية لماذا

يزداد العنصر لـ العدد الذري

Q\ Why do the ionization energies in the periods increase as the atomic number of an element increases

ظهور و النواة الشحنة الموجبة في زيادة السبب

الطاقة المستوى الرئيسي نفس في الإلكترونات

Because of the increase in the positive charge of the nucleus and the occurrence of the electrons in the same main level of energy.

الفراغات املأ

Q\ Fill in the blanks:

يزداد العدد الذري عندما تـــقــــل طاقة التأين

1- The ionization energy <u>decreases</u> when the atomic number <u>increases</u>

الزمرة ضمن

within the <u>group</u>.

يزداد العدد الذري عندما تزداد طاقة التأين

2- The ionization energy <u>increases</u> when the atomic number <u>increases</u>

الدورة ضمن

within one <u>period</u>.

السبب أعط

Q\ Give the reason:

في يزداد العدد الذري عندما تقل طاقة التأين

الزمرة الواحدة

1- Ionization energy decreases when atomic number increases in a single group.

بعيداً تتحرك المستوى الخارجي الإلكترونات السبب الجواب

النواة عن

Answer: Because the electrons of the outer level are moving away from the nucleus.

يسار من نتحرك نحن عندما تزداد طاقة التأين

الدورة ضمن يمين الى الجدول الدوري

2- The ionization energy increases when we move from the left of the periodic table to the right (within the period)?

و النواة ضمن الشحنة الموجبة ازدياد يرجع الى الجواب

الطاقة الرئيسي الخارجي مستوى نفس عند الإلكترونات بقاء / احتجاز

Answer: Due to the increase of positive charge within the nucleus and the retention of electrons at the same level of external primary energy.

ازداد العدد الذري كلما تزداد طاقة التأين
3- The ionization energy increases as the atomic number increases in single period.
في الواحدة الزمرة

و النواة ضمن الشحنة الموجبة ازدياد يرجع الى الجواب
Answer: Due to the increase of positive charge within the nucleus and the retention of electrons at the same level of external main energy.
الطاقة الرئيسي الخارجي مستوى نفس عند الإلكترونات بقاء / احتجاز

طاقة التأين من أكبر طاقة التأين
4- The ionization energy of $_7N$ greater than $_8O$ ionization energy, although oxygen is the largest atomic number of nitrogen atom.
ذرة النتروجين من عدد ذري أكبر هو الأوكسجين بالرغم من

مشبع شبه تمتلك ذرة النتروجين ان السبب الجواب
Answer: The reason that the nitrogen atom has a semi-saturated secondary level is $2P^3$ so the ionization energy is higher
اعلى طاقة التأين لذلك مستوى الثانوي

طاقة تأين اعلى تمتلك العناصر النبيلة
5- Noble elements possess the highest ionization energy.
بسهولة الكتروناتـــها تفقد لا هي السبب الجواب
Answer: Because it does not lose its electrons easily.

عرف الإلكترونية الألفة
Q / Define Electron Affinity

المحايدة عندما متحررة الطاقة من الكمية الألفة الإلكترونية
Electronic Affinity: The amount of energy released when a neutral gaseous atom acquires one electron.
الكترون واحد تكتسب الذرة الغازية

$$F + e^- \rightarrow F^- + \text{energy}$$

الألفة الإلكترونية اقل تمتلك العناصر النبيلة لماذا
Q\ why do Nobel elements have the lowest electron affinity?
لها الكترونات إضافة الصعب جدا لأنها السبب
Because it is very hard to add electrons to them.

Q\ Fill in the blanks:

عندما تزداد الدورات في العناصر لـ الألفة الإلكترونية

1. The electron affinity of the elements in the periods **increases** when the
يزداد العدد الذري
atomic number **increases**.

كلما الإلكتروني الحصول لـ صعوبة اكثر الزمرة نفس في العناصر

2. The elements in the same group more difficulty to acquire an electron as
تزداد أعدادها الذرية
their atomic numbers **increase**.

لـ صعوبة الأكثر للعنصر العدد الذري الأكبر

3. The **bigger** the atomic number of an element, the more difficult for the
الإلكترون اكتساب لـ العنصر
element to acquire an electron.

عرف الكهرسلبية

Q\ define Electronegativity

الكترونات المتآصرة جذب لـ الذرة ميل الكهرسلبية

Electronegativity: The tendency of an atom to attract bonded electrons
المركب الكيميائي أي في نفسها نحو
towards itself in any chemical compound.

Q\ Fill in the blanks:

العدد يعطى وهكذا كهرسلبية اكبر يمتلك الفلور

1. Fluorine has the **greatest** electronegativity and thus, is given number
كهرسلبيتـــه لـ قياس كـ
(4) as a measure for its electronegativity.

كل لـ مقياس كـ مستخدم كهرسلبية الفلور عدد

2. Number of fluorine electronegativity is used as a **measurement** for all
العناصر الأخرى
other elements.

في يزداد العدد الذري عندما تزداد الكهرسلبية

3. Electronegativity **increases** as the atomic number **increases** in the
الاستثناءات بعض مع الدورة
period with some exceptions.

يزداد العدد الذري كلما تقل الكهرسلبية في الزمر

4. In groups, electronegativity **decreases** as the atomic number **increases**.

لا ها بعض بسبب استثنائية تعتبر الغازات النبيلة

5. The noble gases considered exceptional because some of them do not
مركبات صنع لـ بعضها مع اتحاد
combine with others to make compounds.

لـ تميل المركبات صنع لـ الميل تمتلك التي الغازات النبيلة

6. The noble gases that have the tendency to make compounds tend to
الكهرسلبية عالية جدا تمتلك
have a very high **electronegativity**.

استثناء تعتبر الغازات النبيلة لماذا

Q\ Why are the noble gases considered exceptional

مركبات لتكون الأخر مع تمتزج لا بعضها لأن

Because some of them do not combine with others to make compounds.

Q\ Fill in the blanks:

التغيرات وفقاً" لـ تتغير خواص لا فلزية و فلزية

1. The metallic and nonmetallic properties change according to the changes
   الدورة نفس في و الزمرة نفس في للذرة العدد الذري في
   in the atomic number of the atoms in a same group and in a same period.

   ازداد الدورة نفس في للذرات العدد الذري كلما
2. As the atomic number of the atoms in the same period increases, the
   الخواص اللافلزية و من جانب تقل الخواص الفلزية
   metallic properties decrease on one hand, and the nonmetallic properties
   من جانب أخر تزداد
   increase on the other hand.

   اللافلزية و تزداد الخواص الفلزية الزمرة الواحدة في
3. In one group, the metallic properties increase and the nonmetallic
   ازداد العدد الذري كلما تقل الخواص
   properties decrease as the atomic number increases.

   في العناصر فلزية هي الثانية الزمرة و الأولى الزمرة في العناصر كل
4. All the elements in Group IA and Group IIA are metals. The elements in
   لا فلزية هي السابعة الزمرة و السادسة الزمرة
   Group VIA and Group VIIA are nonmetals.

   لا فلزات هي هيليوم و هيدروجين الدورة الأولى في العنصريـــن
5. the two elements in the first period (hydrogen & helium) are nonmetals.

   الى فلزية من تغير تدريجي هنالك الدورات الأربعة التالية في
6. In the following four periods, there is a gradual change from metallic to
   خواص لا فلزية
   nonmetallic properties.

   اثنين اخر ما عدا فلزية هي الدورة السادسة في العناصر كل
7. All the elements in the sixth period are metals except the last two
   لا فلزية هي عنصرين
   elements are nonmetals.

   فلزية فقط تتضمن الدورة السابعة
8. The seventh period includes only metals.

   الفلزية يبين عناصر انتقالية داخلية هي الأكتينيدات و اللانثانيدات
9. Lanthanides and Actinides are internal transitional elements, show metal
   الخواص
   properties.

يقل الحجم الذري (نق) ، تقل الفلزية ، تزداد الكهرسلبية ، تزداد طاقة التأين ، تزداد الخواص اللافلزية ، تزداد الألفة الإلكترونية

ضمن الدورة

ضمن الزمرة
يزداد الحجم الذري (نق)
تقل طاقة التأين
صعوبة قياس الكهرسلبية
تزداد الفلزية
تقل اللافلزية

1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	81 Ti	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra						



أسئلة الفصل الأول غير مترجمة، يجب ترجمتها من قبل الطالب لكي يعتاد على الامتحان النهائي الوزاري.

CHAPTER QUESTIONS 01

1-1 Choose what is correct from the following:

1- The most stable electron is that located in:

a) Fourth primary energy level.
b) Third primary energy level.
c) Second primary energy level.

2- Which one of the following energy levels has more electrons?

a) First primary level.
b) Second primary level.
c) Third primary level.

3. Maximum how many electrons are there in primary energy level n=2?

a) 32 electrons.
b) 18 electrons.
c) 8 electrons.

4-What is the number of orbital of f sublevel?

a) 3 orbitals.
b) 7 orbitals.
c) 5 orbitals.

5-Which of the following electron configuration is correct for d sublevel which has 6 electrons according to Hund's Rule?

a) [↑↓][↑][↑][↑][↑]

b) [↑↓][↑↓][↑↓][ ][ ]

c) [↑][↑][↑][↑][↑↓]

6- The third main energy level contains a number of orbitals:

a) 4 orbitals
b) 9 orbitals
c) 16 orbitals

7- Electron configuration of one of elements is as follows: $1s^2\ 2s^2\ 2p^3$
What is the atomic number of this element?

a) 5 b) 4 c) 7

8- Electronic arrangement of neon element:

a) $1s^2\ 2s^2\ sp^6$

b) $1s^2\ 2s^2\ sp^6 3s^1$

C) $1s^2\ 2s^2\ sp^6 3s^2$

9- In the periodic table the elements of block d are located

a) Below the periodic table.

b) On right of the periodic table.

c) Middle of the periodic table

10-In the periodic table the elements that assemble the right of the periodic table are:

a) Block p elements

b) Block f elements

c) Block s elements

11- Halogens are the elements of the group

a) IA b) VIIA c) VIIIA

12- what is the electronic configuration of an element which end with $3p^3$?

a) $1s^2\ 2p^6\ 3p^3$

b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

c) $1s^2\ 2s^2\ 2p^6\ 3p^3$

13- The discovery of the nucleus of the element is attributed to the scientist.

a) Rutherford

b) Bohr

c) Thomson

14- Atom element ends with electronic level $3s^1$ atomic number of this element is

a) 8 b) 13 c) 11

15- The amount of energy required to remove one electron from the outer energy level of a gaseous atom is called

a) Ionization energy.

b) Electronegativity

c) Electron affinity

16- An atom of an element ends with electronic order in secondary level $2p^5$, what it's group and period.

a) Fifth group, second period.

b) Second group, fifth period

c) Seventh group, second period.

17- An element in the fifth group and the third period, the final secondary energy level is

a) $3p^5$ b) $5p^3$ c) $3p^3$

18- Which of the following elements has highest electronegativity?

a) Fluorine.

b) Chlorine

c) Bromine

19-The radius of elements increases within same period as:

a) It has less atomic number

b) It has larger atomic number

c) As we move from left to right in the same period in periodic table .

20-Which of the following is true for the Lewis structure of argon (Ar) element?

a) ·Ȧr· b) :Ä̤r: c) ·Ar ·

1-2 Explain Rutherford's atomic model and why his model was failed?

Rutherford introduced his perception that:

1. (A positively charged particle, the mass of proton is greater than that of the electron).
2. protons are situated in a tiny area at the center of the atom called the nucleus which contains most of the mass of the atom
3. The electrons circle around the nucleus. Therefore, most of the volume of the atom is avoid, the number of negative electrons rotates around the nucleus balance the positive charge of protons.
4. These electrons rotate around the nucleus in various orbits with varying distances from the nucleus, as is the case of planets rotating around the sun.

If negative electrons are static

No.1 Assumption: these electrons will be drawn to (magnetized) the nucleus with the positive charge.

If electrons must be in constant motion.

No.2 Assumption: Given that moving electric charge which is under gravitational force releases energy, so there must be loss in the energy of the moving electron which would eventually slow down its motion. This slowing down electron would move around in a circular motion and finally falls into the nucleus. **In both assumptions, the atom must collapse.**

1-3 Write briefly about:

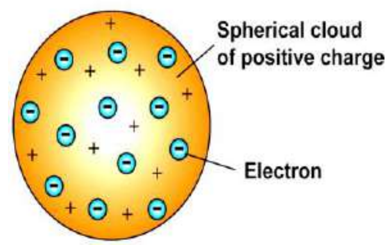
1) **Ionization energy:** The amount of energy required to remove one electron from the outer energy level of a gaseous atom.

Na + ionization energy → Na^+

2) **There is no electronic repel in same orbital:**
Each electron spins around itself at the same time as it spins around the nucleus.

3) **Thomson atomic model:**

Thomson's Model:



By the end of the 19th Century, Thomson gave another perception of the atom.

1- atoms consist of smaller particles having negative charge ,called (electrons)
2- The atom is a positively charged sphere on which negatively charged electrons attached to balance the charge

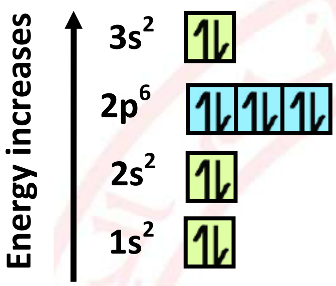
4) **Secondary energy levels:** A number used by scientists, which describe fairly all features of the orbital as well as those the electrons in these orbital.

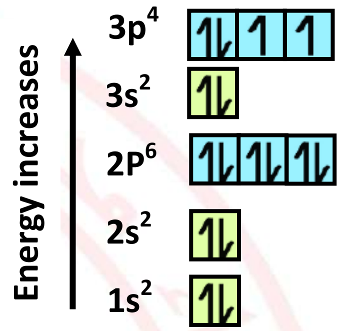
5) **Electronegativity:** The tendency of an atom to attract bonded electrons towards itself in any chemical compound.

1-4 Two elements $_{12}Mg$ and $_{16}S$

1) Write the electronic configuration for them indicating the secondary energy levels

$_{12}Mg$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $_{16}S$ $1s^2$ $2s^2$ $2P^6$ $3s^2$ $3p^4$





2) Period and group of each

$_{12}Mg$ are located in third period and second group

$_{16}S$ are located in third period and sixth group

3) What is common between these two elements in their location in the periodic table?

Period

4) Lewis order for both of them?



1-5 Electron configration for fluorine is $1s^2$ $2s^2$ $2p^5$

1) What is the atomic number for Fluorine? (9)

2) What is the number of secondary energy levels that full with electrons, and named it? (only 2) $1s^2$ $2s^2$

3) What is the number of unpaired electrons in fluorine atom?

$_9F$ $1s^2$ $2s^2$ $2p^5$ (only 1 unpaired electron)



1-6 Arrange elements by decreasing in their atomic size:

$_{2}He$ $_{10}Ne$ $_{18}Ar$

$_{2}He$ $1s^2$

$_{10}Ne$ $1s^2$ $2s^2$ $2p^6$

$_{18}Ar$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$

Notice that all the elements are in the same group (VIIIA)

$_{2}He < _{10}Ne < _{18}Ar$

1-7 What is the common thing between the following elements:

1) $_{3}Li$, $_{1}H$

$_{3}Li$ $1s^2$ $2s^1$

$_{1}H$ $1s^1$

They are in the same group

2) $_{13}Al$, $_{17}Cl$

$_{13}Al$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^1$

$_{17}Cl$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$

They are in the same period

1-8 Name the period and group for each element : $_{18}Ar$, $_{11}Na$

$_{18}Ar$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ eighth group third period

$_{11}Na$ $1s^2$ $2s^2$ $2p^6$ $3s^1$ First group third period

1-9 Write Lewis symbol for each of the following $_{16}S$, $_{5}B$

$_{16}S$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^4$:S:

$_{5}B$ $1s^2$ $2s^2$ $2p^1$ ·B·

1-10 Which elements are called noble gases in the periodic table and what is the most important characteristic of these elements?

last group on the far right of the periodic table. These Elements partly filled with electrons at the secondary shells s and p.

These Elements have a very high electronegativity.

These Elements do not combine with others to make compounds.

1-11 How does elements blocks in the periodic table are arrange, and what it's position?

Depending on the type of secondary level that ends the electronic configuration, for example:

$_{11}Na$ is located in the block s

show its configuration: $_{11}Na$ $1s^2\ 2s^2\ 2p^6\ 3s^1$

Block S is located at the left of the periodic table.

Block P is located at the right of the periodic table

Block d is located in the center of the periodic table

Block f is located below the periodic table

1-12 How many secondary levels and orbitals and electrons in each of primary energy level (second third)?

Primary level	Number of Secondary level	Number of Orbital	Number of Electron
Second	only 2 (2s , 2p)	4 orbital	8 electrons
third	only 3 (3s , 3p , 3d)	9 orbital	18 electrons

1-13 Answer the following questions according to $_{17}Cl$ and $_{11}Na$?

1- Write electron configuration ot them

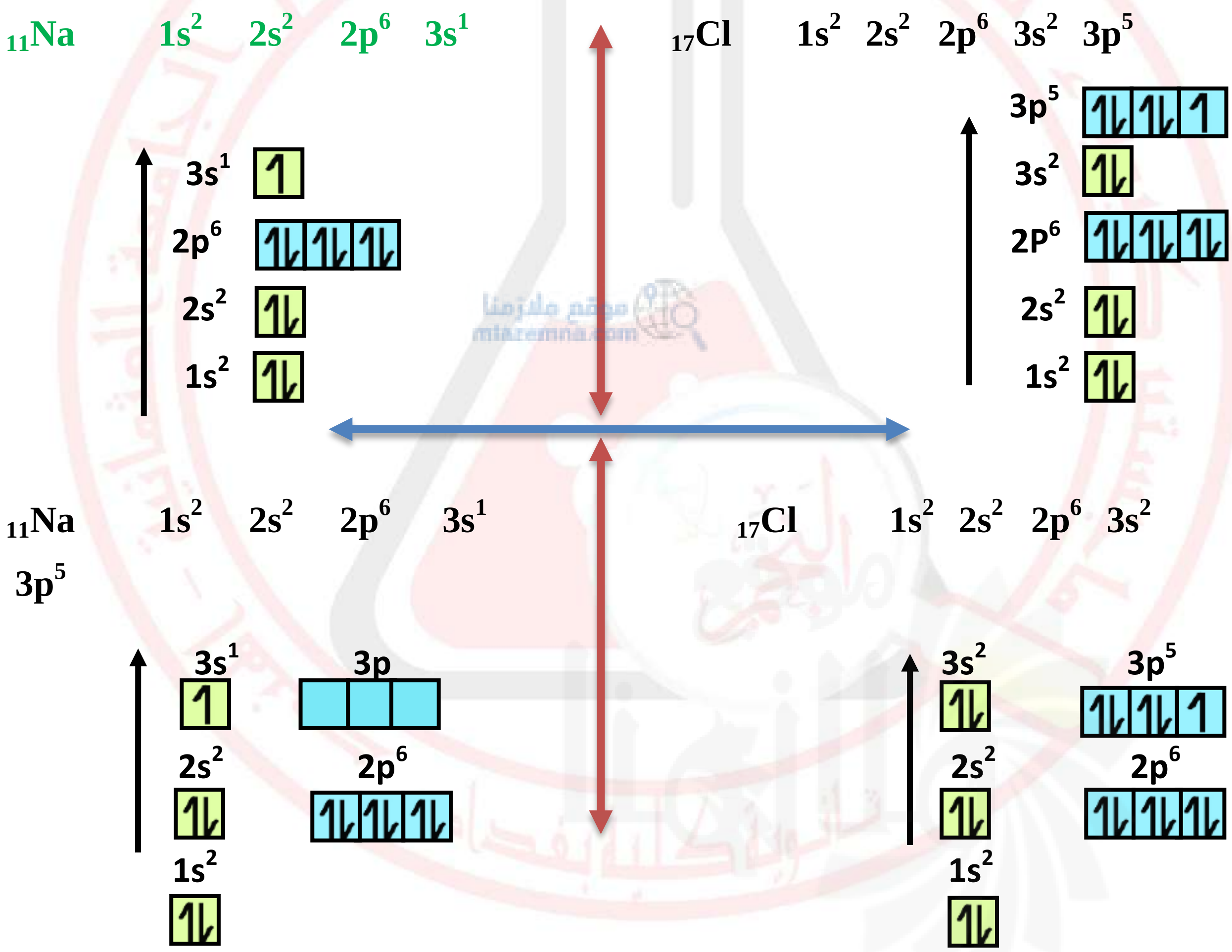
$_{11}Na$ $1s^2$ $2s^2$ $2p^6$ $3s^1$

$_{17}Cl$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$

2- Show Lewis structure



3- Show secondary and primary energy levels.



4- Write number of unpaired electrons.

$_{11}Na$ $1s^2$ [↑↓] $2s^2$ [↑↓] $2p^6$ [↑↓|↑↓|↑↓] $3s^1$ [↑] Only 1 electron

$_{17}Cl$ $1s^2$ [↑↓] $2s^2$ [↑↓] $2p^6$ [↑↓|↑↓|↑↓] $3s^2$ [↑↓] $3p^5$ [↑↓|↑↓|↑] Only 1 electron

5- Number of electrons for each primary energy level around each nucleus.

Sodium: $_{11}Na$ $1s^2\ 2s^2\ 2p^6\ 3s^1$

The first primary level n = 1 contains 2 electrons

The second primary level n = 2 contains 8 electrons

The third primary level n = 3 contains 1 electron

Chlorine: $_{17}Cl$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

The first main level n = 1 contains 2 electrons

The second main level n = 2 contains 8 electrons

The third main level n = 3 contains 7 electrons

6- Number of secondary energy level that are filled with electrons.

Sodium contains three levels of secondary energy filled with electrons: 1s 2s 2p

Chlorine contains four secondary energy levels filled with electrons: 1s 2s 2p 3s

7- period and group for each atom and what is the common characteristic between them

The sodium is located in the third period and the first group.

Chlorine is located in the third period and seventh group.

These elements located in the same period (third period).

1-14 How Metal and nonmetallic properties are classified in for each (second period . fifth group).

Second period: contains two elements of lithium and beryllium of metals, boron of semi-metals, carbon, nitrogen, oxygen, fluorine and nonmetals.

Fifth period: all its elements are metal, except four (two semi-metals, two non-metals)

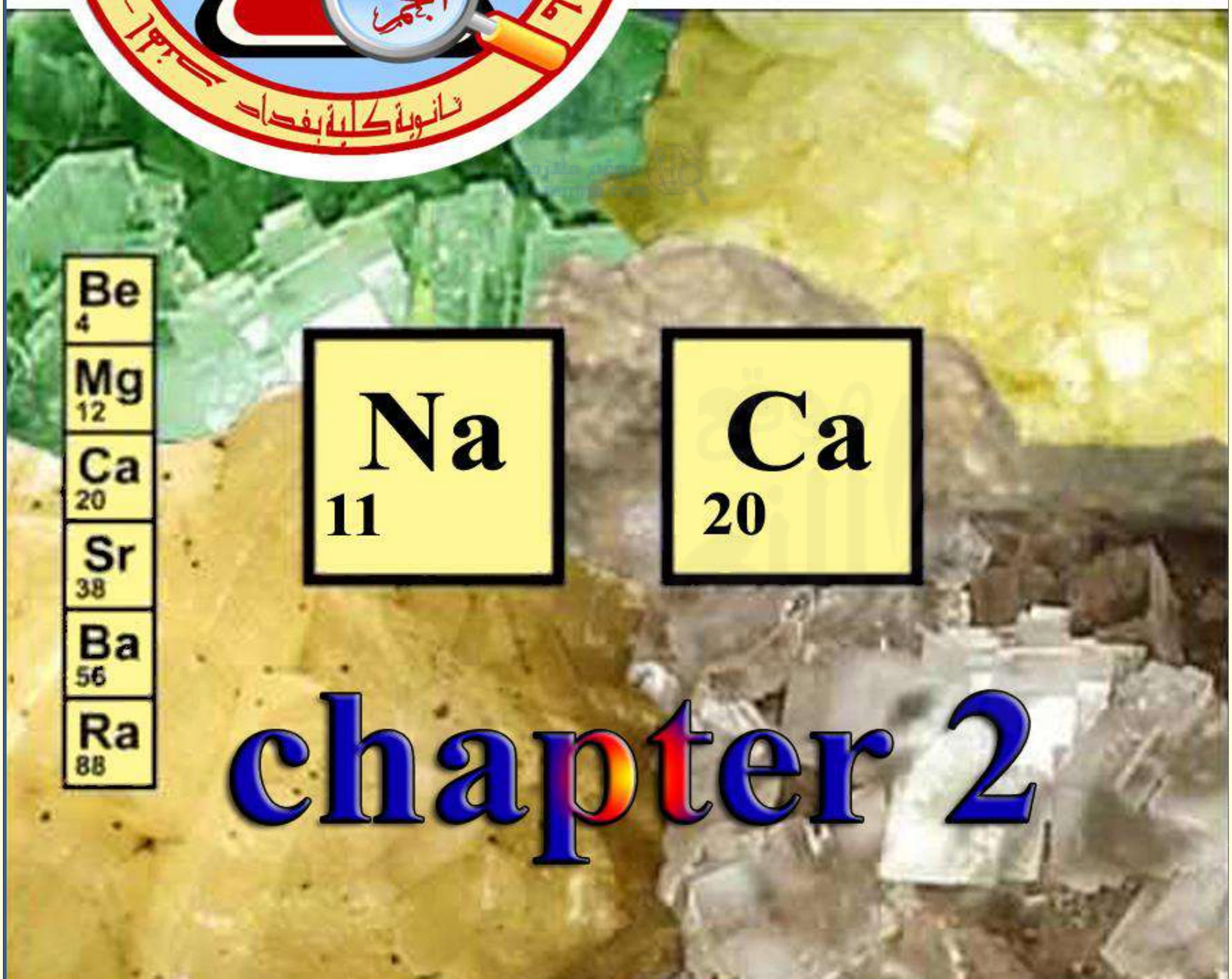
كيمياء المتميزين

شرح مفصل
ترجمة علمية

مع النجم في الكيمياء

الصف الثالث متوسط

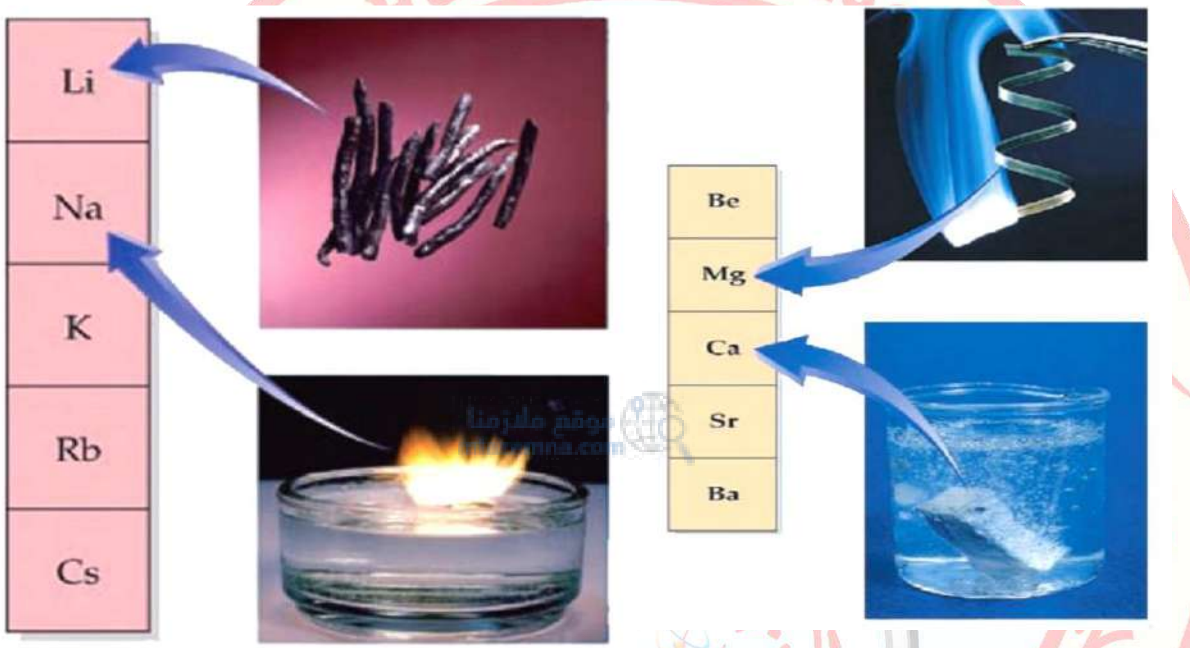
م.م. محمود علي النجم
كلية بغداد



chapter 2

Chapter 2

Groups IA and IIA



1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub						

58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

عزيزي الطالب – عزيزتي الطالبة
سوف تكون الترجمة فقط للكلمات التي لم تذكر في الفصل الأول.
اقرأ المصطلحات الموجودة في نهاية الفصل لتسهل قراءة الفصل

Q \ Where is the first and second group on the periodic table?

Answer: They are found on left of the periodic table and called **S-Block**

عدد
Q \ List the elements of the first and second group.

Q\ Fill in the blanks :

1 - The first group consists: Lithium (Li), sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), Francium (Fr)

2 - The second group consists: Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba), Radium (Ra).

Q\ Fill in the blanks :

1- The first group is called alkaline metals (الفلزات القلوية) and the second group (زمرة الثانية) alkaline earth metals (القلوية الأتربة فلزات).

2- The elements are arranged in the first group and the second according to increase in their atomic numbers.

3- Francium (الفرانسيوم هو) is the only element in the first group which is prepared (فقط العنصر في الأولى الزمرة الذي المحضر) industrially (صناعيا)

العامة الخصائص / مميزات

Q / What are the general characteristics of elements of the first and second groups?

1- They have low electronegativity and low ionization energy.

2- The outer shells of all the elements in group IA have one electron.

3- The outer shells of the elements in group IIA have two electrons.

أنها لا تحدث حرة بشكل في الطبيعة

4- They can't occur the free form in nature.

Q\ Why are not the elements of IA and IIA groups free form in nature?

بسبب فعاليتـــها

Because of their reaction. (it's very active)

Q\ Compare the elements of the first and second group from where:

From where	Group IA	Group IIA
Metallic properties	more metallic	Less metallic
Ionization energy	less ionization energy	Higher ionization energy
Number of electrons in the last energy level	Only one electron	Only two electron
Electronegativity	less electronegativity	Higher electronegativity

Q\ Why is the ionization energy of the elements in Group IIA greater than those of the elements in Group IA

because of the decrease in the atomic volume.

Q\ What are the physical properties of group IA and IIA elements?

نقاط الغليان و الانصهار

1. Melting and boiling points decrease when the atomic numbers of the elements increase.
2. The compounds of these metals give different colors to the flame of Benzene Lamp. (لهب بنزن لمصباح)
3. The increase and decrease in the density of elements (كثافة) are irregular (غير منتظم) to the increase in their atomic numbers.
4. the density of (Li,Na and K) is lower than the density of water at the temperature of (25 C).



Q\ Why is potassium ($_{19}K$) less melting and boiling than lithium ($_{3}Li$)?

Melting and boiling points decrease when the atomic numbers of the elements increase.

Q\ Filling in the blanks:

1. Lithium gives scarlet (قرمزي) color.
2. Sodium compounds give shiny yellow (لامع اصفر) color.
3. Calcium gives dark red (احمر داكن) color.
4. Strontium gives scarlet (قرمزي) color.
5. Barium gives yellowish green (مصفر اخضر).
6. (K, Na and Li) is lower than the density of water at the temperature of (25 C).

Q / What are chemical properties of the IA and IIA group elements?

1- The elements in Group IA have one valence electron
2- The elements in Group IIA have two valence electrons in their outer shells.
3- They have the tendency to lose their valence electrons when they enter into a chemical reaction.
4- Elements in group IA form positively charged ions (M^+) and elements in group IIA form (M^{+2})
5- It is combine with nonmetals to form stable salts with high solubility except (عدا) Lithium which is less soluble in water like NaCl

Q\ Give the reason :

1- Elements of AI and AII groups are combining with nonmetals to form stable salts with high solubility except Lithium which is less soluble in water.
Because, lithium has small volume and the great (كبيرة) attraction (جذب) energy of its nucleus to electrons.

2- They tend (تميل) to lose (لفقدان) the external (الخارجي) covalence (التكافؤ) electrons (إلكترونات) easily (بسهولة).
because they are easily oxidized.

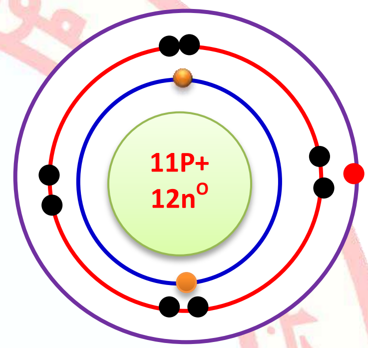
3- Elements of group IA are called "alkaline metals"
because their solutions are very basic.

4- Elements of group IIA called "alkaline earth metals"
because some of their oxides are known as "alkaline earth"

Sodium الصوديوم

Q / Give the following to the sodium element: chemical symbol, atomic number, mass number, oxidation number and then draw the electronic configuration.

chemical symbol	Na
atomic number	11
mass number	23
electronic configuration	$1s^2\ 2s^2\ 2p^6\ 3s^1$
oxidation number	+1
Number of proton Number of electron	z = p = e =11
Number of neutron	n = A – Z n= 23-11 n = 12



Q\ Where does the sodium element occur? يحدث

طبيعة

1- Sodium does not occur as a free element in nature.
2- It occurs in nature combined with other elements forming stable compounds such as NaCl, Na_2SO_4 and Na_2SiO_3.

لماذا الصوديوم في يخزن النفط النفط الأبيض

Q\ Why is sodium stored in petroleum (white oil) ?

1- because it does not react with it.

بسبب انه يحترق عندما تعرضه للهواء

2- because it burns when exposed to air.

Q\ what are the physical properties of sodium element ?

ناعم فلز و يمتلك لامع فضى بريق عندما قطع

1. It is a soft metal and has a bright silvery luster when it is cut.
2. Its density is less than the density of water.
3. It melts down at (97.81 °C).
4. It boils at (882.9 °C).

Q\ Complete the following chemical equations, with balance.

تفاعل مع كلام من تحب ببطئ
واجعل الكلام الجارح
كـ العامل المساعد
يدفعك إلى الأمام بأقل زمن

$2Na + Cl_2 \longrightarrow 2NaCl$

Sodium — Chlorine Gas — Sodium Chloride

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Sodium — Water — Sodium Hydroxide — Hydrogen gas

$2Na + MgO \longrightarrow Na_2O + Mg$

Sodium — Magnesium Oxide — Sodium Oxide — Magnesium

$2Na + 2HCl \longrightarrow 2NaCl + H_2$

Sodium — Hydrochloric Acid — Sodium Chloride — Hydrogen gas

$3Na + AlCl_3 \longrightarrow 3NaCl + Al$

Sodium — Aluminum Chloride — Sodium Chloride — Aluminum

Q\ What are uses of Sodium?

1. It is used as an active reducing agent in some of the organic interactions. (العضوية التفاعلات)
2. It is used in the production of sodium cyanide (NaCN) which is used in purifying gold. (تنقية الذهب)
3. It is used in mining (تعدين) to remove (ازالة) the oxygen of air which is combined with the metals.

Q\ give the reason:

1- Sodium is used as an active reducing agent in some of the organic interactions.
because of its high oxidation.

2- Sodium is used in mining (تعدين) to remove the oxygen of air which is combined with the metals.
because it is active reducing agent

ذكر اللون في سؤال
الكشف جدا جدا مهم

Q\ How is sodium ion detected in its compounds?

use a detection called dry detection

When the sodium is burned on a benzene lamp.

the lamp flame is colored in yellow.



مهم

Q\ Define Dry detection.

تحديد

Dry Detection: Detect used to Determination an element in a composite by

تعيين

specifying the color of the element on a flame benzene lamp.

Q\ what are the most important compounds of sodium?

1- sodium chloride ($NaCl$)
2- sodium carbonate (Na_2CO_3)

Q\ How do sodium carbonate salts form in nature?

Double salts containing On the sodium element + Rain water with air on the CO_2 gas → sodium carbonate (dry matter)

Q\ Where is the table salt ($NaCl$) in nature?

صخرة بلدان

1. It occurs in nature as rock salts in many countries around the world.

رواسب

2. It occurs as underground salt deposits.

متوفرة مع هائلة كميات في ينابيع بحار و بحيرات

3. It is abundant with huge quantities in springs, seas and lakes.



كيف يمكن استخراج ملح في الجنوبي الجزء من العراق

Q\ How can Extraction of Salt in southern part of Iraq?

If salt exists with high concentrations in sea water:

الماء يضخ ل كبيرة أحواض مسطحة لتبخرها بواسطة الشمس

The water is pumped into large shallow pools to be vaporized by the sun.

Q\ What are the Uses of Sodium Chloride?

1. It is indispensable (ضروري) in our food.
2. It is used in the preparation (تحضير) of many sodium compounds such as sodium carbonate (washing soda).
3. it is used in preservation (وقاية) of consumable (استهلاكية) food such as meat and fish.
4. It is used in leather (الجلود) tanning (دباغة).
5. production of ice for cooling and painting (الأصباغ) adhesives (مثبت).

Q\ Why is Sodium chloride used in preservation of consumable food for certain period of time such as meat and fish?

Because the concentrated sodium chloride liquid kills harmful (مضر) bacteria (بكتريا) which case (حالة) putridity (التعفن).

Q\ What is the difference between table salt and sodium chloride?

1. Put some crystals of pure sodium chloride in a glass (زجاجي) bowl (وعاء) and put some salt (table salt) in another.
2. Put the two glass bowls in humid (الرطب) air (الهواء) and label (تميز بلاصق) the bowls (أطباق) individually (فردي).
3. After one or two days, check (افحص) the salt in the bowls.
4. You notice that the regular (منتظم) salt becomes humidified (رطب) and the pure salt stays (يبقى) unaffected (غير متأثر).
5. This indicates that sodium chloride does not absorb water from air, i.e. it does not hydrate. Regular salt has the property of absorbing water (humidity) (رطوبة) from air.
6. The reason for this hydration is that it contains impurities of calcium chloride or magnesium chloride or both.

Q\ Why does sodium chloride not absorb water from air (it does not hydrate). And regular salt has the property of absorbing water (humidity) from air?

The reason for this hydration is that it contains impurities of calcium chloride or magnesium chloride or both.

Q\ Define Hydrolysis.

امتصاص

Hydrolysis : The process of absorbing water from air being wet .

Q\ Define Sodium hydroxide

Sodium hydroxide: is a base with a great tendency to dissolve in water.

الذوبان


Sodium Hydroxide

Q\ Why are Sodium hydroxide not fully diluted?

Because : The hydrated layer of sodium hydroxide reacts with carbon dioxide in air to form a layer of sodium carbonate Na_2CO_3 which is insoluble (غير قابل للذوبان) in concentrated NaOH solution. A dry layer is formed on sodium hydroxide.

Such as :

$$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$$

Q\ What are the most important uses of sodium hydroxide?

1- In the manufacture (صناعة) of soap (الصابون) and detergents (المنظفات).

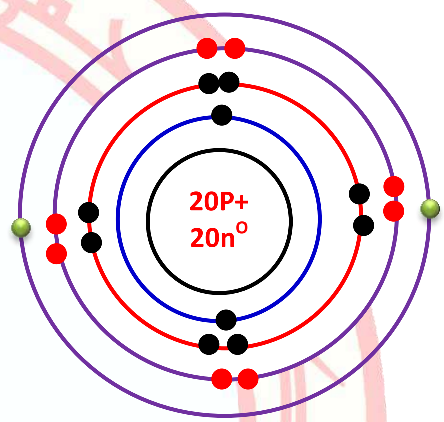
2 - In the manufacture (صناعة) of textiles (منسوجات) and paper (الورق).

3 - A raw material in the preparation (تحضير) of compounds used in industry.

Calcium الكالسيوم

Q / Give the following to the calcium element: chemical symbol, atomic number, mass number, oxidation number and then draw the electronic configuration.

Chemical symbol	Ca
Atomic number	20
Mass number	40
Electronic Configuration	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
Number of proton Number of electron	$Z = p^+ = e^- = 20$
Number of neutron	n = A – Z n= 40-20 n = 20



Q\ Where does the calcium element occur?

Why? answer

1. It does not occur as a free element in nature because of its high activity.
2. It occurs in some kinds of food such as milk and fish.
3. It occurs in combination of other elements as in the forms:
   a) carbonate such as alabaster (المرمر) and limestone (حجر الكلس)
   b) sulfate such as plaster (الجص)
   c) Phosphates such as Calcium Phosphate
   d) Silicate. ($CaSiO_3$)



Some food that contain calcium.

الحصول على
Q\ How can calcium obtained?
استخراج
Q\ How is Calcium extracted from its compounds?

مصهور التحليل الكهربائي
Calcium is obtained by the method of electrolysis of molten calcium chloride and fluoride.

Q\Why does Calcium not occur as a free element in nature?

because of its high activity.

Q\ Prepare Calcium Hydroxide $Ca(OH)_2$.

اضافة الجير
It is prepared by adding water to calcium oxide CaO (quicklime).

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Q\ Define :

الجير تحضير
1. lime: Calcium oxide (CaO) used in the preparation of calcium hydroxide.
إطفاء الجير
2. hydrating lime: - is a process used in the preparation of calcium hydroxide.
المطفأ الجير
3. Hydrated Lime: Calcium hydroxide is the result of adding water to calcium oxide (CaO).
الصافي الجير ماء
4. Pure lime water: is pure calcium hydroxide solution $Ca(OH)_2$.

Q / How can detect calcium hydroxide solution (pure lime water).

Q / How is carbon dioxide detected.


Calcium hydroxide

Answer: CO_2 is detected by the calcium hydroxide solution where the solution is turbid, because of the formation
ابيض راسب
Calcium carbonate in a white precipitate.

$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$$

Q\ What is the different between normal plaster and Paris Plaster

	normal plaster	Paris Plaster
Chemical Formula	$CaSO_4.2H_2O$	$(CaSO_4)_2.\ H_2O$
Formation	two molecules of water, One molecule of calcium sulfate	One molecule of water two molecules of calcium sulfate
Occurrence	Occur from combine water with solid calcium sulfates.	From heating gradually for plaster turns (normal plaster)

Q\ define crystallization water , Paris Plaster

H.W

Crystallization water:

Paris Plaster:

Q\ What are the uses of Paris plaster?

Paris plaster is used in:

1- building البناء 2- statue making صنع التماثيل 3- casting التجبير

اركض خلف هدفك حتى يتحقق
فكم من عطشان ركض خلف سرابه
فوجد من بعد ذلك شرابه MANAR

CHAPTER QUESTIONS 02

2-1 **Choose from the brackets to complete the scientific meaning in the following:**

1- **Which one is the first group elements?**

a) Helium b) Radium c) Sodium d) Boron

2- **Why potassium is more active than element of lithium?**

Its atom has two valence electron.

Its atomic radius bigger.

Its atom don't have valence electron.

Because its free in nature.

3- **What is the oxidation number of magnesium element in its compounds?** (1 , 2 , 3 , 4)

4- **If Lithium atom loses its equivalence electrons, it convert to** (single positive charge ion , a negative charge, dipositive charge ion , di-negative charge ion)

2-2 **What is the difference between normal plaster and Paris plaster?**

	normal plaster	Paris Plaster
Chemical Formula	$CaSO_4.2H_2O$	$(CaSO_4)_2. H_2O$
Formation	two molecules of water One molecule of calcium sulfate	One molecule of water two molecules of calcium sulfate
Occurrence	Occur from combine water with solid calcium sulfate.	rom heating gradually for plaster turns (normal plaster)

2-Why sodium chloride is important for industry?

Cause: Sodium chloride brings many materials used in many industrial Paper .

3- Barium has more metallic properties than beryllium. Why?

Barium and beryllium are in the same group.

As the metal increases as the atomic number increases within the group,

So, Barium is more metallic than Beryllium because it is the most atomic number

3-2

Explain the reason of followings:

1) Aluminum, Al, is not found in IA group.

$_{13}Al$ $1s^2\ 2s^2\ 2p^6\ \underline{3s^2\ 3p^1}$

Because it has 3 electrons in a last primary energy level.

2) Sodium is stored in petroleum.



A. because it does not react with them
B. because it burns when exposed to air.

3) IA group is called alkaline metal.

because their solutions are very basic.

4) Sliced Sodium loses its shining after some time.

Because of the formation of a layer of sodium oxide resulting from the reaction of sodium with air oxygen air.

5) When granules NaOH are left in wet atmosphere, they first fade and then form a hard shell.

The hydrated layer of sodium hydroxide reacts with carbon dioxide in air to form a layer of sodium carbonate Na_2CO_3 which is insoluble in concentrated NaOH solution. A dry layer is formed on sodium hydroxide. Such as :

$$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$$

4-2

Explain:

1- Calcium loses two electrons easily

$_{20}Ca$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$

From the electronic configuration of calcium we observe that the electronic valence are located in the fourth level (far from the nucleus) So when the electron moves away from the nucleus, its energy increases and the electron becomes less correlated with the nucleus so it is easier to lose.

2- Put the elements Lithium, Sodium, and Potassium within the same group, although different in the atomic number.

$_{3}Li$ $1s^2$ $2s^1$

$_{11}Na$ $1s^2$ $2s^2$ $2p^6$ $3s^1$

$_{19}K$ $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^1$

From electronic configuration:

- It contains one electron in its outer shell.
- So, they have the same physical and chemical properties so they located in the same group.

What is the difference between pure salt (NaCl) and impure (NaCl)

Pure salt (NaCl)	Impure salt (NaCl)
Does not contain impurities	Contains impurities such as magnesium chloride and calcium chloride
It can't absorb water molecules from the air	It can absorb water molecules from the air

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Chapter 3

3rd class

Groups IIIA



Chapter 3

Groups IIIA



Boron (B)



Aluminum (Al)



Gallium (Ga)



Indium (In)

عزيزي الطالب – عزيزتي الطالبة
سوف تكون الترجمة فقط للكلمات التي لم تذكر في الفصول السابقة.
اقرأ المصطلحات الموجودة في نهاية الفصل لتسهل دراستـــه

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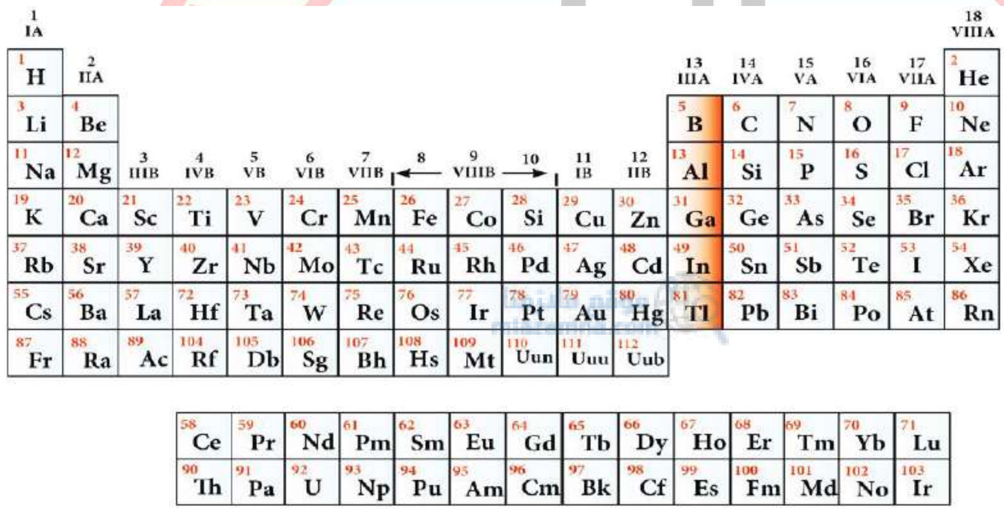
Group IIIA الزمرة الثالثة

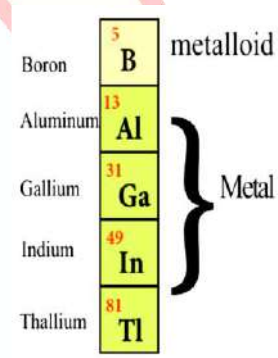
Q\ Why are the elements of group IIIA put one group?

beacuse the outer shell in IIIA group atoms contains same number of electrons despite (على الرغم) they are different in their atomic numbers.

Q\ List The elements of IIIA group.

Boron (B), Aluminum (Al), Gallium (Ga), Indium (In), Thallium (Tl).





Q\ Write the general properties of group IIIA elements

1-The elements of this group are metals except (عدا) Boron which is metalloid.

2-The ionization energy of these elements is less than the ionization energy of group IIA elements.

3- The oxidation number of these atoms is (+3). However, they tend actually (في الواقع) to form covalent bonds.

4- The oxides and hydroxides of the elements of this group are characterized with an increase in the alkaline characteristic and a decrease in the acidic characteristics as the atomic number increases.

Exercise 3-1

Q\ Compare between the ionization energy of elements in group IIIA and IIA.

Q\ Why is the ionization energy of these elements less than the ionization energy of group IIA elements.

The main reason is that the elements of this group contain one electron in the secondary shell (p) following a saturated secondary shell (whether s or p).

Q\ Why is the oxidation number of group IIIA atoms(+3).

Because it has 3 valence electrons in the last primary energy level.

Q\ Why are the aqueous solutions of boron oxides are acidic, whereas the aluminum oxides are amphoteric.

المائية المحاليل بينما

because the atomic number is increases.

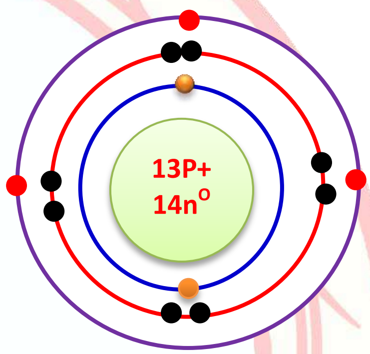


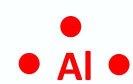
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Aluminum الألمنيوم

Q / Give the following to the Aluminum element: chemical symbol, atomic number, mass number, oxidation number and then draw the electronic configuration.

chemical symbol	Al
atomic number Z	13
mass number A	27
electronic configuration	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
oxidation number	+3
Number of proton Number of electron	$z = p^+ = e^- = 13$
Number of neutron	$n = A - Z$ $n = 27-13$ $n = 14$





Q\ Where does the Aluminum element occur (يوجد)?

1- Aluminum does not occur as a free element in nature (طبيعة).

2- Aluminum is the most abundant (وفرة) metal in the earth's crust (قشرة).

3- It makes up about 8 % by weight (وزن) of the earth's solid surface

Such as bauxite (البوكسايت) $Al_2O_3.2H_2O$, Cryolite (الكريولايت) Na_3AlF_6

Q\ List The raw (الخام) material (المواد) of aluminum.

1- bauxite $Al_2O_3.2H_2O$

2- Cryolite Na_3AlF_6

Q\ Define : 1- bauxite 2- Cryolite 3- Hall process

استخلاص الالمنيوم

Bauxite: It is the aqueous aluminum oxide and it is the main source for aluminum extraction. With chemical formula $Al_2O_3.2H_2O$.

سداسي

2- **Cryolite**: is a fluoride of sodium and aluminum (sodium hexafluoroaluminate) it is one of the most important sources used in the extraction of aluminum. With chemical formula (Na_3AlF_6).

طريقة هول

واسع موثوق بها

3- **Hall process**: is the major industrial process for aluminum extraction in the present time. It is the best and reliable process and is widely used in industry

Q\Why does Aluminum not occur as a free element in nature?

because of its high activity.

Q\ Explain the process of Extraction of Aluminum (Hall process)

للحصول على الشوائب لاستبعاد ينقى كيميائياً

الومينا

1- The Bauxite ($AL_2O_3.2H_2O$) is chemically purified to exclude impurities to obtain pure aluminum oxide (AL_2O_3) (alumina) which has a high melting point.

يخفض منصهر

answer

why

2- alumina is melted it in molten cryolite. The molten cryolite decreases the melting point of alumina.

تيار خلية كهربائية يصب

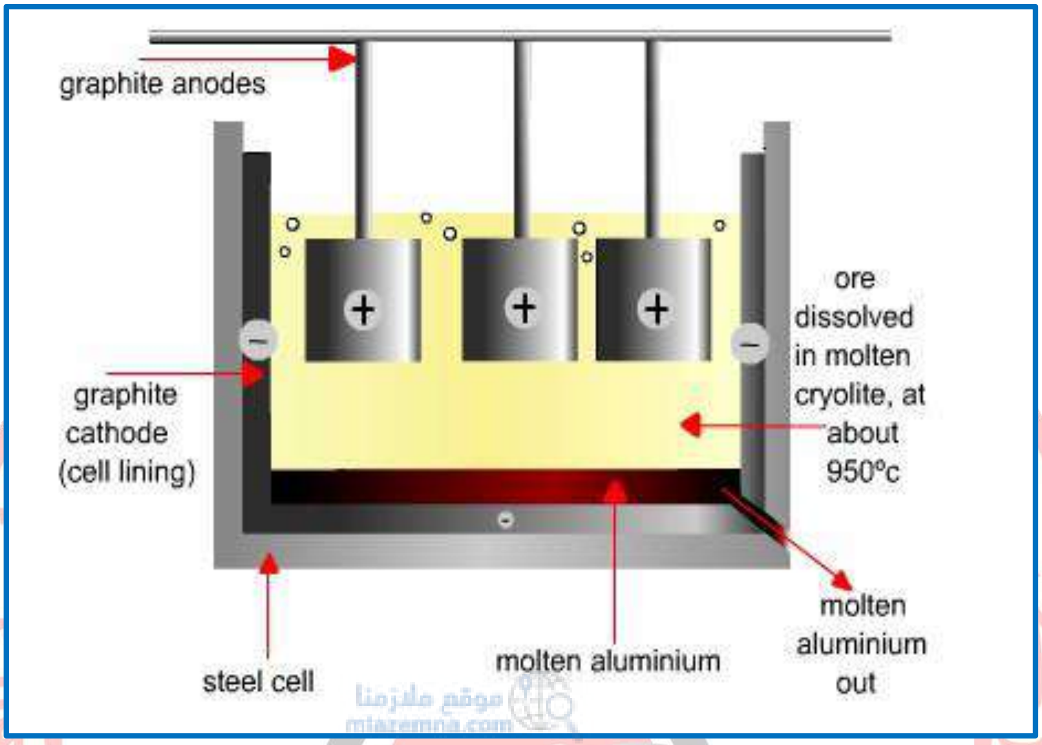
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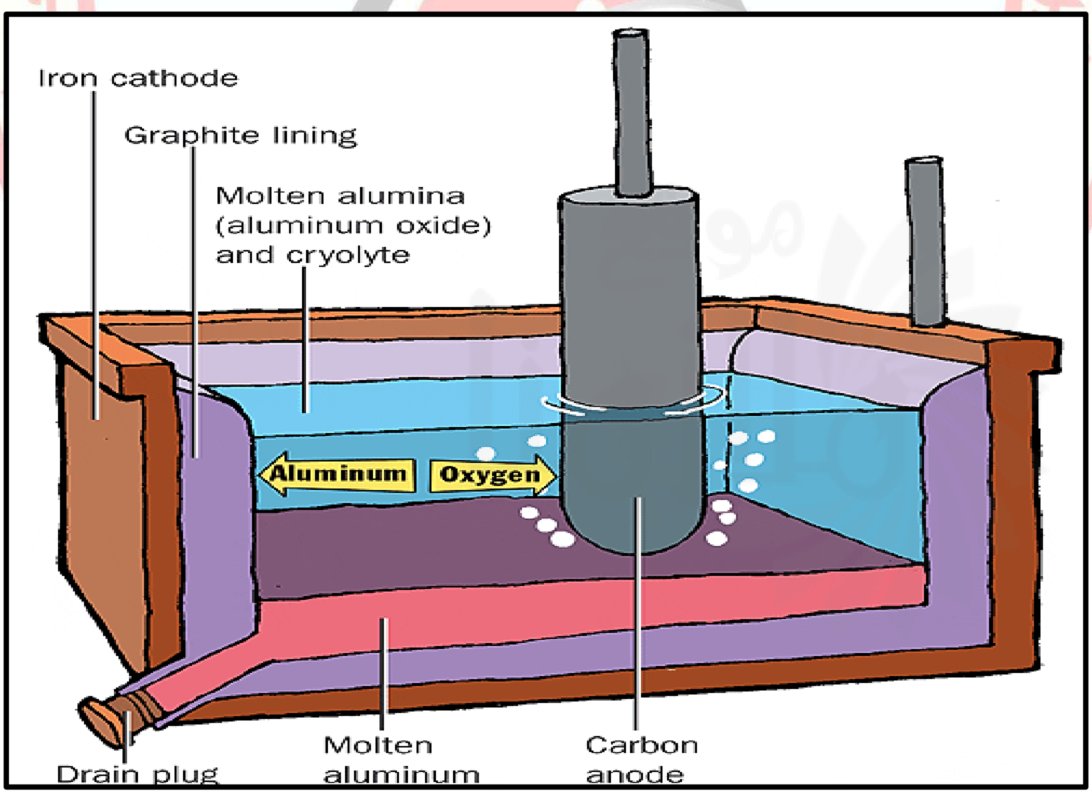
3- The molten, then, is poured in an electrolytic cell. As the current passes through. Aluminum accumulates at the bottom of the cell.

تدريجيا يسحب

4- Then, the molten aluminum is pulled gradually.

اختر احد الرسمين عند الاجابة





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Q\ What are the properties of Aluminum?

1. Aluminum is silvery metal
2. It has low density
3. It is a good conductor for heat and electricity.

Q\ Give the reason.

القدرة مقاومة الصدأ

1- The aluminum element has the ability to resist rust. This does not happen with iron.

يتعرض ل

Aluminum when exposed to air, it is covered with a thin layer of its oxide

تلتصق بقوة منع

which sticks firmly to its surface and prevents further oxidation.

Q\ Complete the chemical equations with the balance.

Aluminum powder + oxgyen gas →

$4Al + 3O_2 \rightarrow 2Al_2O_3$ + energy

Aluminum powder + Iron (III) oxide →

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$ + high temperature

Gaseous Aluminum + dilute hydrochloric acid →

$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$



Q\ Explain Thermite reaction

Q\ Aluminum is a reducing agent

1. Put a mixture of aluminum powder and Iron (III) oxide Fe_2O_3 in a crucible (جفنة) with some sand.
2. Also, put a tape (شريط) of magnesium of an appropriate (مناسب) length in the container and light the end of the tape (شريط) and keep a distance from the container not less than three meters.
3. notice the reaction between the aluminum powder and iron (III) oxide
4. The reaction is so vigorous (قوي) with a great amount of heat, shiny flame (لهب) and a lot of sparks (شرارة).
5. The reaction results in molten iron as the aluminum reduces iron (III) oxide and releases molten iron due to excessive (الزائدة) heat, this reaction is called "Thermite process", as in following formula:

$$4Al + Fe_2O_3 \rightarrow 2Al_2O_3 + 2Fe + \text{High temperature}$$

Q\ What are the uses of Thermite reaction

1- This reaction is used in welding (لحيم) steel machines and railways (السكك الحديدية) bars (قضبان).

2- Aluminum is also used to extract some metals from their ores (الخامات) which exist in the form of oxides.

Q\ Why is Aluminum used to extract metals from their oxides?

Because Aluminum is a reducing agent.

Q\ Explain reaction of aluminum with acids and bases.

Q\ Explain Amphoteric Behavior of aluminum.

1- Aluminum reacts with dilute (مخفف) hydrochloric acid easily to produce hydrogen gas and aluminum chloride component.
2- Aluminum **does not** reacts with both concentrated (مركز) and dilute nitric acid continually.
3- Aluminum reacts with basic solutions like sodium hydroxide or potassium hydroxide to release hydrogen gas and aluminum salt

Q\ Aluminum does not react with both concentrated and dilute nitric acid continually. Why?

Q\ Using aluminum containers for storing (خزن) nitric acid. Why?

Because aluminum oxide (Al_2O_3) forms a layer which isolates (تعزل) the acid from the metal, therefore the reaction stops.

Q\ Why is the behavior of aluminum called Amphoteric behavior?

Because: When the aluminum interacts with the bases and the acid releases hydrogen gas and aluminum salts.

Q\ When the aluminum interacts with the bases and the acid, will release hydrogen gas and aluminum salts. Why?

Because Aluminum has Amphoteric behavior

Q\ why does aluminum with "self-protection" protect itself against erosion?

تتعرض لـ طبقة ثابتة

Because when the aluminum exposed to air, it forms a thin but firm layer of aluminum oxide which sticks to the metal and protects it from oxidation

Q\ Iron isn't a metal with "self-protection" against erosion. why?

Q\ Why does the erosion (تأكل) continue with iron ?

Because the thin layer of iron oxide (erosion) is very thin and fragile, it lets air, oxygen and humidity penetrate the metal.

Q\ what are the usages of Aluminum

وزاري

1. Aluminum can be used in electrical wires.
2. thin layers of aluminum are used to foods, medications
3. making various shapes and sizes of cans.
4. Thin aluminum alloys are used to make kitchen utensils (اواني), plates (Fafon), chairs
5. Aluminum alloys are also used to make cans and containers to preserve (حفظ) liquids at a very low temperature such as oxygen, argon and nitrogen reserve
6. it is mixed with elements to making alloys, such as lead, copper, zinc and magnesium.







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Q\ Aluminum is used in electrical wires in on a limited level

because is expands and shrinks 39 % more than copper when expose to the same heat.

يتوسع و يتقلص

Q\ Define the Fafon

Fafon : Aluminum alloys are used to make kitchen utensils, plates, chairs and many other products in Iraq.

سبيكة أواني

Q\ Aluminum alloys are used to make cans and containers to preserve liquids at a very low temperature such as oxygen, argon and nitrogen reserve . why?

because of the fact that the lower the temperature the harder aluminum gets

Q\ what elements which mixed with aluminum to make alloys?

They are Lead, Copper, Zinc and Magnesium.

Q \ list the Aluminum alloys?

1-Duralumin Alloy (ديور المنيوم) 2- Aluminum Bronze Alloy (المنيوم برونز)

Q\ define: Duralumin Alloy and Aluminum bronze Alloy

1- Duralumin Alloy: This alloy consists of a high percentage of aluminum and a small amount ratio of copper and magnesium. It might contain manganese as well. This alloy is light and hard so it is used for building aircraft parts.

الطائرات اجزاء

2- Aluminum bronze Alloy: This alloy consists of a small percentage of aluminum and a high ratio of copper and other metals sometimes. It is characterized by resistance (مقاومة) to erosion, its color changes according to colors of its component parts, <u>ranging (تتراوح) from copper color to gold color and silver color</u>, therefore it is used to make decoration (زينة / زخرفة) materials.

Q\ Compare between Duralumin Alloy and Aluminum bronze Alloy

Duralumin Alloy	Aluminum bronze Alloy
consists of a high percentage of aluminum and a small amount ratio of copper and magnesium.	consists of a small percentage of aluminum and a high ratio of copper and other metals sometimes.
It might contain manganese as well. This alloy is light and hard	It is characterized by resistance to erosion, its color changes according to colors of its component parts.
it is used for building aircraft parts.	it is used to make decoration materials.

Q\ Why is Duralumin Alloy used for building aircraft parts?

Because This alloy is light and hard.

Q\ Why is Aluminum bronze Alloy used to make decoration materials?

Because its color changes according to colors of its component parts.

Q / What are the most important aluminum compounds with chemical formula?

1- Aluminum hydroxide $Al(OH)_3$
2- Aluminum Oxide Al_2O_3
3- Alum الشب $KAl(SO_4)_2.12H_2O$

Q\ How can you prepare Aluminum hydroxide $Al(OH)_3$

It is result of a reaction between aluminum aqueous solutions of aluminum salts like (aluminum sulfate) $Al_2(SO_4)_3$ with sodium or potassium hydroxide

Aluminum hydroxide is a white gelatin material insoluble in water.

Q\ How can you prepare the Aluminum Oxide Al_2O_3?

by heating of aluminum hydroxide a formula as in the following

$$2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$$

Q / How can you prepare the double salts (alum)?

1- Two equal amounts of aqueous aluminum sulfate and potassium sulfate are mixed

يتبخر

2- Allow the mixture so that water evaporates

3- The result would be salt crystals containing aluminum sulfate & potassium sulfate along with crystallized water molecules in a fixed mass ratio.

4- The general formula for Alum is $KAl(SO_4)_2.12H_2O$. It is also called Potassium alum.



Q\ Define Alum.

Alum: is one of aluminum compounds with general formula for Alum is $KAl(SO_4)_2.12H_2O$. It is also called Potassium alum.

Q\ What are Alum usages?

معقمة مادة للجروح

1. As a Sterile material for wounds.

اصباغ مثبت على المنسوجات

2. It is used to make dye permanent on textiles
3. In purifying drinking water.

Q\ Why is alum used to sterilize some light wounds?

رواسب على الجروح

because it dissolves in water and $Al(OH)_3$ deposits on the wound and stops

تخثر

blood so it clot.

Q\ Explain Test of Aluminum ions in Solution of Aluminum Compounds?

تحديد

Q\ How can you identify Aluminum ion in its compounds? مهم

Aluminum ion is identified in its compounds by basic solution such as sodium hydroxide or potassium hydroxide whereby they react with aluminum ion Al to form a <u>white gelatin</u> deposit which is aluminum hydroxide $Al(OH)_3$ as in the following formula:

$$\underset{\text{Aluminum ion}}{Al^{3+}} + \underset{\text{Sodium hydroxide}}{3NaOH} \rightarrow \underset{\text{Aluminum hydroxide}}{Al(OH)_3\downarrow} + \underset{\text{Sodium ion}}{3Na^{+}}$$

For example:

$$AlCl_3 + 3NaOH \rightarrow Al(OH)_3\downarrow + 3NaCl$$

Q\ Why is $Al(OH)_3$ dissolved when sodium hydroxide NaOH is added?

because dissolved sodium aluminate is formed.

Q\Why is $Al(OH)_3$ also dissolved when an acid is added?

because of the amphoteric behavior.

ليس الغني من ترك المال لمن بعده

بل الغني من ترك الذكرى الجميلة في قلوب الاخرين



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CHAPTER QUESTIONS 03

1-3

Which of the following is not found in group IIIA.

a) $_{31}$Ga b) $_{13}$Al c) $_{12}$ Mg d) $_{5}$B

2-3

Choose from the brackets to complete the scientific meaning in the following terms:

1-What is the role of Aluminum for Thermite reaction?

a) Catalysis b) Reducing agent c)Oxidizing agent

2-What is the percentage of aluminum in aluminum bronze alloy?

a) High b) Small c) 100 %

3- Galium Ga is a member of group (first, second, third)

3-3

Complete the following statements

1-Aluminum reacts with acids to release hydrogen gas, while when reacts with bases it release hydrogen gas because amphoteric behavior.

2- The effect of oxygen in air on Aluminum don't lead to corrosion as in the case of iron because it is covered with a thin layer of its oxide which sticks firmly to its surface and prevents further oxidation.

3- Heavy heating of Aluminum hydroxide gives Aluminum oxide, energy , water .

4- Salt composed from potassium and aluminum elements called Alum

5- The Aluminum behavior when reacts with acids and bases is called amphoteric behavior.

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4-3

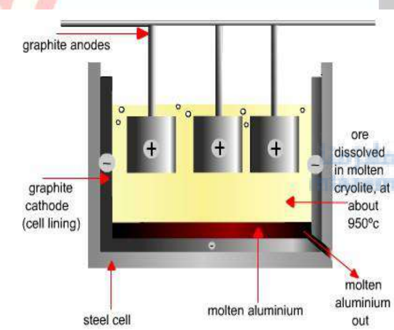
Explain the extraction of aluminum and draw the figure.

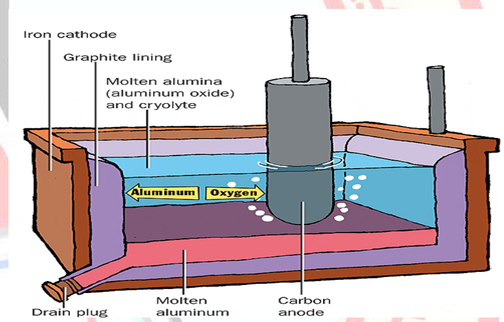
1- The Bauxite ($AL_2O_3.2H_2O$) is chemically purified to exclude impurities to
للحصول على الومينا
obtain pure aluminum oxide (AL_2O_3) (alumina) which has a high melting point.

2- alumina is melted it in molten cryolite. The molten cryolite decreases the melting point of alumina.

يصب كهربائية خلية تيار
3- The molten, then, is poured in an electrolytic cell. As the current passes
يتراكم
through. Aluminum accumulates at the bottom of the cell.

يسحب تدريجيا
4- Then, the molten aluminum is pulled gradually.





5-3

Select from list what fits each statement in the list (A)

List A	List (B)
1- An element with amphoteric behavior.	Aluminum
2- A reaction in which Aluminum reacts as reduced agent and releases high heat energy that dissolves iron.	Thermite
3- Aluminum oxide	Alumina
4- Double salt of potassium sulfate and aluminum	Alum
5- One element of group IIIA which is semi metal	Boron

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كيمياء المتميزين مع النجم

CHAPTER 4

Solutions and Expression for Concentration



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Chapter 4

Solutions and Expression for Concentration



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Q\ Solutions are important in chemistry science with a great extent, especially liquid solutions. Why?

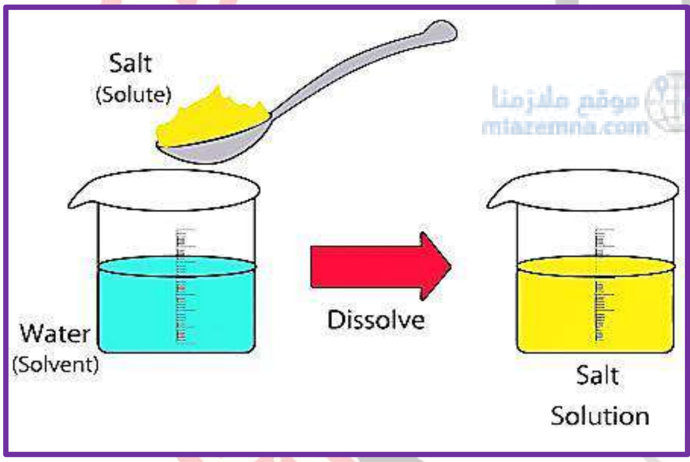
because they are the medium for chemical reactions, whereby they help to happen interaction among reacting substances.

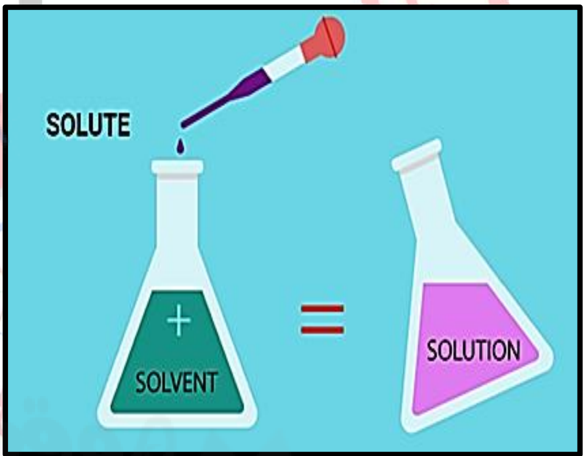
Q\ Define :

Solution: It is a homogeneous mixtures composed of two or more pure substances having no chemical reaction between them.

Solvent : is substance with majority in the solution.

Solute: material with less existence in the solution.



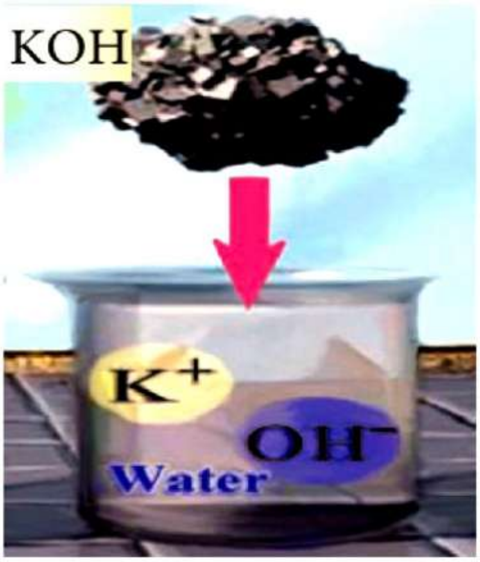


Solute + Solvent → Solution



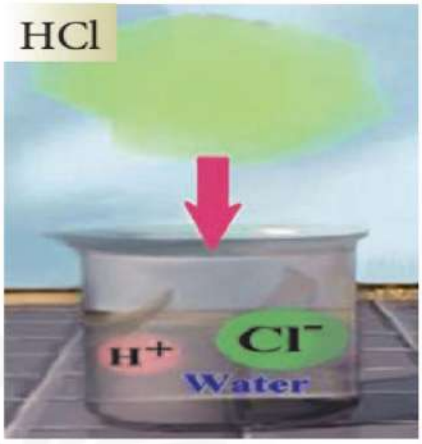
Q\ List Types of Solutions.

The most important and most common are liquid solutions, i.e., when the solvent is liquid.



* solutions can be prepared by dissolving a solid material in a liquid, as in the case of dissolving salt (NaCl) in water to get the saline solution or dissolve sodium hydroxide in water (basic solution).

* From dissolving liquid in another liquid, like dissolving alcohol in water.



* A gas can be dissolved in a liquid such as dissolving hydrogen chloride (HCl) in water, the resulting solution is called hydrochloric acid solution (acidic solution).

$$HCl \xrightarrow{H2O} HCl$$

Hydrogen chloride gas — Solution of hydrochloric acid

**dissolving gas in another gas like air or a solid solution in another solution like various alloys, mostly coins and gold alloys.

Note: in this chapter we will only study liquid solutions.

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Q\ What are the reasons behind the different names and nature of solutions?

Nature and Names of solutions vary according to the amount of the solvent and the solute and also the nature of the dissolving process.

Q\ Define the following :

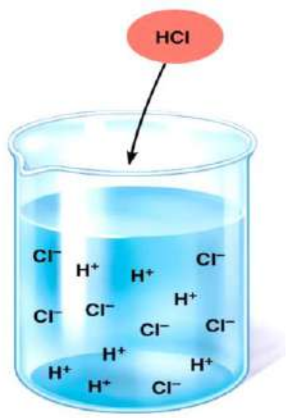
Saturated solution : is the solution which contains a greater amount of the solute and the solvent can dissolve no more of solute at the given temperature and pressure.

Super saturated solution: Is the solution in which amount of the solute is greater in any solution that the solvent is able to dissolve it under normal conditions and this kind of solution is not stable.

Unsaturated solution: is the solution which contains less amount of the solute that is required for saturation at a particular temperature and pressure.

Electrolytic solution: in this solution the solute molecules ionize in the solution. The solute can be strongly ionized or weak electrolyte

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Strong electrolyte: its molecules are completely ionized in the solution like hydrochloric acid

$$HCl \xrightarrow{H2O} H^{+} + Cl^{-}$$

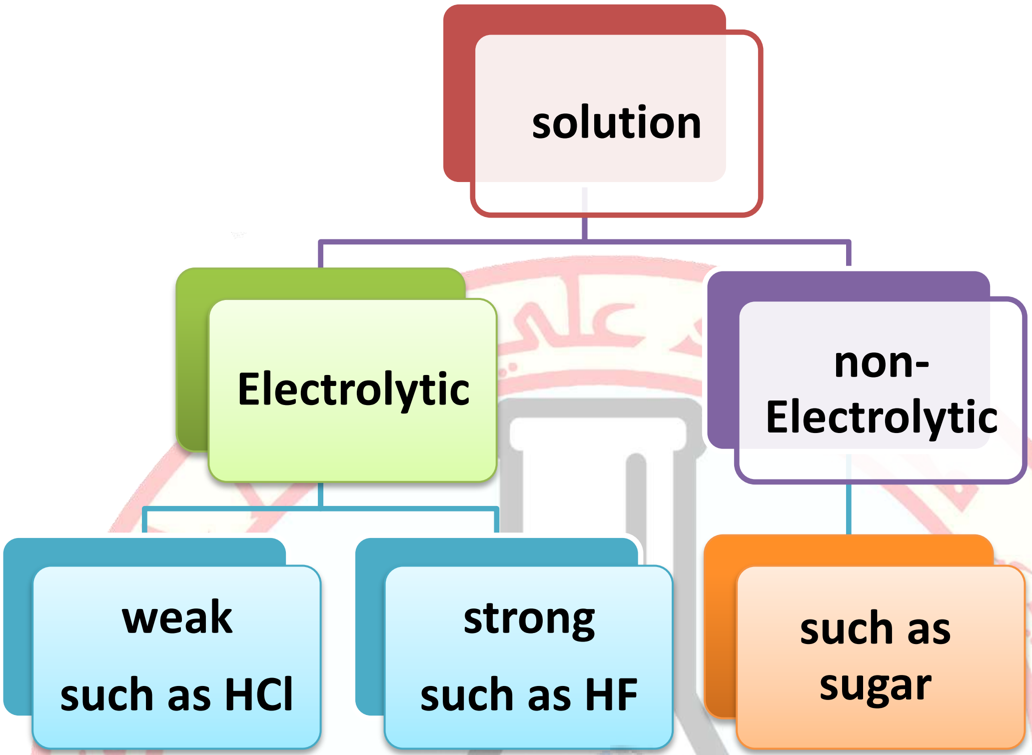
Weak electrolyte: its molecules are partially, moderately or slightly ionized like hydrofluoric acid, whereby it slightly ionizes in the solvent, its ions are at equilibrium with the non-ionized molecules. $HF \rightleftharpoons H^{+} + F^{-}$

Note: reversed arrows indicate that the slightly ionized substance is at equilibrium with the resulting ions.

non-electrolytic solutions : compounds whose molecules don't ionize at all, such as sugar or ethyl alcohol in water.

Q\ What are the differences between electrolyte and non-electrolyte solution?

Electrolyte solution	non-electrolyte solution



Q\ Define Solubility قابلية الذوبان

Solubility: is the maximum amount of a solute which can be dissolved in a given amount of a specific solvent to result in a saturated solution at a given temperature.

> **Note**: Solubility varies according to the nature of the solute and the solvent, temperature and pressure.

Q\ What does solubility depend on?

1- nature of the solute and the solvent.

2- temperature.

3- pressure.

Q\ why?

1- The salt crystals dissolve faster if the beaker is shaken, when a small amount of table salt is added into water in a beaker.

because the process of shaking helps to contact the surface of crystals with water even greater.



2- Do we stir tea with a spoon when sugar is added?

because the process of solubility has to do with surfaces which are exposed to dissolution.

3- Sugar powder dissolves faster than lumps of sugar?

because the surface of the powder is greater exposed to the solvent than lumps of sugar.

Q\ Fill in the blanks:



1- the nature of polarity determines its solubility.

2- Like dissolves like.

3- Polar solvents dissolve polar solutes and vice versa.

Q\ Define insoluble substance:

Insoluble substance: is a matter which doesn't dissolve. No matter how long they are left in the solution or how hard they are stirred.

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Q\ why is Sugar in the hot liquid dissolves faster than that in the cold liquid.

because the motion energy of the liquid molecules increases, making it more likely to collide with surfaces of sugar crystals.

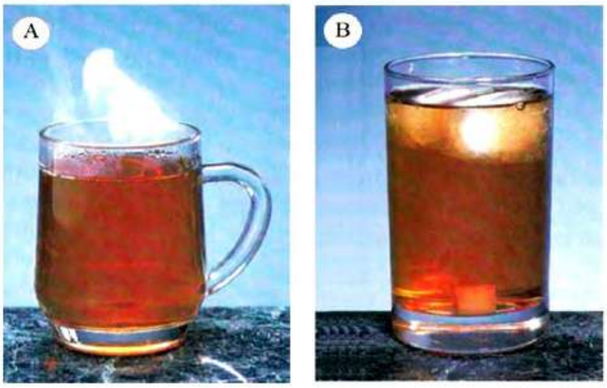


Figure 4-6
A) Sugar dissolves in cold water slowly.
B) Sugar dissolves in hot water quickly.

Q\ Fill in the blanks:

1- gaseous materials, their solubility are <u>increases</u> when the pressure of gas on the surface of the solution <u>increases</u>.

2- in carbonate beverages, the <u>concentration</u> of dissolved carbon dioxide CO_2 in the liquid depends on the <u>pressure</u> of CO_2 on the surface of the beverage.

3- in Soft drinks when the cover is removed, CO_2 pressure will <u>decrease</u> and making it less soluble, bubbles are formed and move up in the liquid.



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Q\ When the cover is removed in Soft drinks, bubbles are formed and move up in the liquid. Why?

because: CO_2 pressure will decrease and making it less soluble

Q\ Define the following:

1- **concentration of the solution**: it is the amount of solute in a particular solvent or solution.

2- **Dilute solutions:** Solutions with relatively small amount of solute.

3- **Concentrated Solutions**: solutions with large amount of the solute.

Q\ Fill in the blanks:

1- The concentration of the solution can be descriptively or qualitatively expressed.

2- A concentrated solution can be changed into dilute by adding a larger amount of the solvent.

Q / How can the concentrated solution be converted to diluted and vice versa?

diluted solution + Solute → concentrated solution

concentrated solution s + Solvent → diluted solution

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Q\ Define Concentration by Mass percentage:

Concentration by Mass percentage: It is the number of grams of the solute which are dissolved in 100 grams of the solution. The percentage of mass ratio of the solute and the solvent is calculated as follows:

$$\text{Mass ratio of any component of the solution} = \frac{\text{mass of component}}{\text{mass of solution}} \times 100\%$$

لحساب النسبة المئوية الكتلية للمذاب نستخدم :

$$\text{percentage concentration of solute} = \frac{\text{mass of solute } (m1)}{\text{mass of solution } (mT)} \ x\ 100\%$$

لحساب النسبة المئوية الكتلية للمذيب نستخدم :

$$\text{percentage concentration of solvent} = \frac{\text{mass of solvent } (m2)}{\text{mass of solution } (mT)} \ x\ 100\%$$

لحساب كتلة المحلول نستخدم:

$$m_1 + m_2 = m_T$$

هذه القوانين مهمة جدا جدا

Example 4-1

What are the ratio of the solute and the solvent of a solution made of 15.3 g of salt dissolved in 155 g of water.

Solution:

Mass of solute: m_1 =15.3g , Mass of solvent: m_2 = 155 g

Mass of solution $m_T = m_1 + m_2$ = 15.3 +155 = 170.3 g

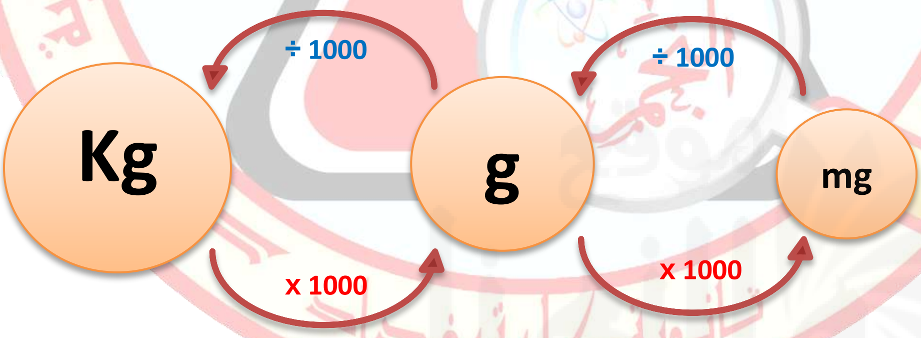
$$solut\% = \frac{(m_1)}{(m_T)}\ x\ 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)}\ x\ 100\%$$

$$solute\% = \frac{15.3}{170.3}\ x\ 100\% \qquad solvent\% = \frac{155}{170.3}\ x\ 100\%$$

$$solute\% = \frac{15300}{1703}\ \% \qquad solute\% = \frac{15500}{170.3}\ \%$$

$$solute\% = 8.98\% \qquad solute\% = 91.02\%$$

وحدات الكتلة هي : kg , g , mg



Exercise 4-1

A solution is formed by dissolving 48.2 g of sugar in 498 g of water. What are the mass ratio of sugar and water in the solution?

Solution:

Mass of solute: $m_1 = 48.2g$, *Mass of solvent:* $m_2 = 498\ g$

Mass of solution $m_T = m_1 + m_2 = 48.2 + 498 = 546.2g$

$$solute\% = \frac{(m_1)}{(m_T)}\ x\ 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)}\ x\ 100\%$$

$$solute\% = \frac{48.2}{546.2}\ x\ 100\% \qquad solvent\% = \frac{498}{546.2}\ x\ 100\%$$

$$solute\% = \frac{48200}{5462}\ \% \qquad solvent\% = \frac{49800}{549.2}\ \%$$

$$solute\% = 8.82\% \qquad solvent\% = 91.18\%$$

Example 4-2

A sample of vinegar contains 4 % of acetic acid by mass . How many grams of vinegar is required to obtain 20 g of acetic acid?

Solution:

$solute\% = 4\%$, Mass of solute: $m_1 = 20\ g$, Mass of solution $m_T = ?\ g$

$$\text{mass percentage } of\ solute = \frac{mass\ of\ solute\ (m_1)}{mass\ of\ solution\ (m_T)}\ x\ 100\%$$

$$solute\% = \frac{20}{m_T}\ x\ 100\%$$

$$m_T = \frac{2000}{4}$$

$$m_T = 500g$$

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Exercise 4-2

20 g of hydrochloric acid is diluted by 80 g of water. What are the mass ratio of the acid and water in the solution?

Solution:

Mass of solute: m_1 =20g , Mass of solvent: m_2 = 80 g

Mass of solution $m_T = m_1 + m_2$ = 20+80 = 100g

$$solute\% = \frac{(m_1)}{(m_T)}\ x\ 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)}\ x\ 100\%$$

$$solute\% = \frac{20}{100}\ x\ 100\% \qquad solvent\% = \frac{80}{100}\ x\ 100\%$$

$$solute\% = 20\% \qquad solvent\% = 80\%$$

ملاحظة مهمة للتحقق من الحل
يجب ان يكون مجموع النسبة المئوية للمذاب والمذيب = 100%

$$solute\% + solvent\ \% = 100\%$$

H.W

30 g of hydrobromic acid and 100 g of solution. What is the mass ratio of water in the solution?

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Q\ Define Concentration by volume percentage:

Concentration in volume percentage: It is ratio of volume of each component of the solution compared to the total volume of the solution multiplied by 100.

لحساب النسبة المئوية الحجمية للمذاب نستخدم :

$$\text{percentage } concentration\ of\ solute = \frac{Volume\ of\ solute\ (v_2)}{Volume\ of\ solution\ (v_T)}\ x\ 100\%$$

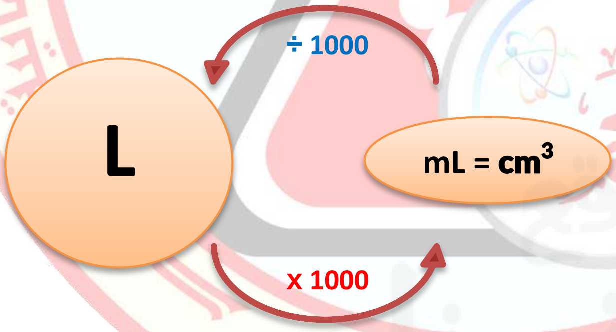
لحساب النسبة المئوية الحجمية للمذيب نستخدم :

$$\text{percentage } concentration\ of\ solvent = \frac{Volume\ of\ solvent\ (v_2)}{Volume\ of\ solution\ (v_T)}\ x\ 100\%$$

لحساب حجم المحلول نستخدم:

$$V_{1\ (g)} + V_{2\ (g)} = V_{T\ (g)}$$

وحدات الحجم هي : L , mL , cm^3



ملاحظة : يمكن تحويل وحدات الحجم من خلال عملية الضرب او القسمة

- في حالة تحويل الوحدة من الاكبر L الى الاصغر mL او cm^3 نستخدم عملية الضرب
  1L = 1000 mL
  1L = 1000 cm^3
  1mL = 1 cm^3
- في حالة التحويل من الوحدة الاصغر mL او cm^3 الى الاكبر L نستخدم عملية القسمة على 1000

Example 4-3

Calculate the percentage of volume for both acetic acid and water in a solution formed by mixing 20 mL of acetic acid and 30 mL of water.

Solution:

Volume of the solute: V_1 = 20 mL , Volume of the solvent: V_2 = 30 mL

Volume of the solution V_T $V_T = V_1 + V_2$ = 20 + 30 = 50 mL

$$solute\% = \frac{(V_1)}{(V_T)}\ x\ 100\% \qquad solvent\% = \frac{(V_2)}{(V_T)}\ x\ 100\%$$

$$solute\% = \frac{20}{50}\ x\ 100\% \qquad solvent\% = \frac{30}{50}\ x\ 100\%$$

$$solute\% = \frac{2000}{50}\ \% \qquad solvent\% = \frac{3000}{50}\ \%$$

$$solute\% = 40\% \qquad solvent\% = 60\%$$

Example 4-4

What is the volume of ethyl alcohol expressed in mL that is required to be added into water so that the total volume of the solution would be 50 ml, and its percentage of volume would be 80 % .

$$solute\% = \frac{(V_1)}{(V_T)}\ x\ 100$$

$$80\% = \frac{V_1}{50}\ x\ 100\%$$

$$V_1 = 40mL$$

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Exercise 4-3

If 80 mL of pure water is added to 20 mL of sulfuric acid, what will be percentage of volume for both sulfuric acid and water?

Solution:

Volume of the solute: V_1 = 20 mL , Volume of the solvent: V_2 = 80 mL

Volume of the solution V_T $V_T = V_1 + V_2$ = 20 + 80 = 100 mL

$$solute\% = \frac{(V_1)}{(V_T)} \ x\ 100\% \qquad solvent\% = \frac{(V_2)}{(V_T)} \ x\ 100\%$$

$$solute\% = \frac{20}{100} \ x\ 100\% \qquad solvent\% = \frac{30}{100} \ x\ 100\%$$

$$solute\% = \frac{2000}{100}\ \% \qquad solvent\% = \frac{8000}{100}\ \%$$

$$solute\% = 20\% \qquad solvent\% = 80\%$$

Expressing Concentration by Mass / volume:

$$\text{concentration}(g/L) = \frac{mass\ of\ solute\ m_1}{volume\ of\ solution\ v_T}$$

Q\ Define of density

Density : is the unit for volume mass. If density is symbolized by the Latin character (p), density is expressed by the following relation:

$$\text{density}(g/L) = \frac{mass\ (g)}{volume\ (L)} \qquad p(g/L) = \frac{m\ (g)}{v\ (L)}$$

Other units can be used for volume like (mL) or (cm^3)

Example 4-5

5 grams of copper sulfate are dissolved in 0.5 L of distilled water. Calculate the concentration of solute in the solution with g/L unit.

Solution:

$$\text{concentration}(\text{g}/L) = \frac{m_1}{v_T} = \frac{5}{0.5} = 10\ g/L$$

Example 4-6

Calculate the mass percentage of methyl alcohol in a solution containing 27.5 g of methyl alcohol and 175 mL of water and assume that density of water is 1.00 g/mL

Solution:

$$p(\text{g}/L) = \frac{m_2\ (g)}{V_2\ (L)}$$

$$1 = \frac{m}{175}$$

$$m_2 = 175\ g$$

$$m_1 + m_2 = m_T$$

$$27.5 + 175 = 202.5\ g$$

$$solute\% = \frac{27.5}{202.5}\ x\ 100\%$$

$$solute\% = \frac{27500}{2025}\ \% \quad = \ 13.6\%$$

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Exercise 4-4

What should be mass of sodium hydroxide dissolved in 1 L of pure water in order to obtain a solution with 0.5 g/L concentration?

$$\text{concentration}(g/L) = \frac{m_1}{v_2}$$

$$1 = \frac{m_1}{0.5}$$

$$m_1 = 0.5g$$

Exercise 4-5

KCl is 5.80 % by mass in a solution Calculate mass of KCl in 0.337L of the solution. (Suppose that density of the solution is 1.05 g/mL.)

Solution: $V_{T\,(mL)}$ = 0.337 X 1000 = 337 mL

$$p(g/L) = \frac{m_T\ (g)}{V_T\ (L)}$$

$$1.05 = \frac{m_T}{337}$$

$$m_T = 353.85\ g$$

$$solute\% = \frac{m_1}{m_T}\ x\ 100\%$$

$$5.80\% = \frac{m_1}{353.85}\ X\ 100\%$$

m_1 = 20.52g

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CHAPTER QUESTIONS 04

4-1 Describe the following :

الجواب ضمن شروحات الفصل

Solution - concentrated solution - concentration by age Solution saturated solution - solubility - electrolytic mass percentage concentration in volume percent

4-2 1-Which answer is true example for solid solution?

a) Juice b) Coin c) Salt solution

2-What is the definition of weak electrolyte solution?

a) If solute ionize completely in solvent .

b) If solute not completely ionize in solvent.

c) If solute fast ionize in solvent.

3-The solubility of the sugar in hot water is faster than cold water. What is the main reason of this?

a) The energy of water molecule reduces under high temperature.

b) The energy of water molecule increases under high temperature.

c) The energy of sugar molecule increases under high temperature.

4- How can we convert concentrated solution to dilute solution?

a) by the help of increasing concentration of solute

b) heating solution

c) by the help of adding much more solvent to solution.

4-3 Compare the following terms:

a) Dilute and concentrated solution.

Dilute solution	concentrated solution
Contains a relatively small amount of solute	Contains a large amount of solute
Can be converted to diluted by adding amount of solvent	It can be converted into a concentrated by adding amount of solute

b) Weak electrolytic and strongly electrolytic solution.

Weak electrolytic	strongly electrolytic
dissolved molecules are fully ionized	dissolved molecules are completely dissolved
its ions are at equilibrium with the non-ionized molecules.	its ions aren't at equilibrium with the non-ionized molecules.
$HF \rightleftharpoons H^+ + F^-$	$HCl \longrightarrow H^+ + Cl^-$

c) Super saturated and unsaturated solution.

Super saturated solution	unsaturated solution
amount of the solute is greater in any solution that the solvent	contains less amount of the solute
It is able to dissolve it under normal conditions	It is required for saturation at a particular temperature and pressure
this kind of solution is not stable.	this kind of solution is stable.

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4-4 There is 19 g dissolved matter in 158 g solvent, find mass percentage of the matter.

Mass of solute: m_1 =19g , Mass of solvent: m_2 = 158 g

Mass of solution $m_T = m_1 + m_2$ = 19 + 158 = 177g

$solute\% = \frac{(m_1)}{(m_T)} \times 100\%$ | $solvent\% = \frac{(m_2)}{(m_T)} \times 100\%$

$solute\% = \frac{19}{177} \times 100\%$ | $solvent\% = \frac{158}{177} \times 100\%$

$solute\% = \frac{1900}{177}\ \%$ | $solvent\% = \frac{15800}{177}\ \%$

$solute\% = 10.73\%$ | $solvent\% = 89.27\%$

4-5 5g of copper sulfate is dissolved in 20 g of pure water, calculate mass percentage of solute and solvent.

Mass of solute: m_1 =5g , Mass of solvent: m_2 = 20 g

Mass of solution $m_T = m_1 + m_2$ = 5 + 20 = 25g

$solute\% = \frac{(m_1)}{(m_T)} \times 100\%$ | $solvent\% = \frac{(m_2)}{(m_T)} \times 100\%$

$solute\% = \frac{5}{25} \times 100\%$ | $solvent\% = \frac{20}{25} \times 100\%$

$solute\% = \frac{500}{25}\ \%$ | $solvent\% = \frac{2000}{25}\ \%$

$solute\% = 20\%$ | $solvent\% = 80\%$

4-6 **How many liters of water is needed to add 10 g of potassium hydroxide to obtain a solution with 2.05 g/L concentration?**

$$\text{concentration}(g/L) = \frac{m_1}{v_2}$$

$$2.05 = \frac{10}{v_2} \Rightarrow v_2 = 4.87L$$

4-7 **If 25 mL HCl and 75 mL water are mixed, what will be percentage of acid and water by volume in the solution?**

Solution:

Volume of the solute: $V_1 = 25$ mL , Volume of the solvent: $V_2 = 75$ mL

Volume of the solution V_T $V_T = V_1 + V_2$ = 25 + 75 = 100 mL

$$solute\% = \frac{(V_1)}{(V_T)}\ x\ 100\% \qquad solvent\% = \frac{(V_2)}{(V_T)}\ x\ 100\%$$

$$solute\% = \frac{25}{100}\ x\ 100\% \qquad solvent\% = \frac{75}{100}\ x\ 100\%$$

$$solute\% = \frac{2500}{100}\ \% \qquad solvent\% = \frac{7500}{100}\ \%$$

$$solute\% = 25\% \qquad solvent\% = 75\%$$

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4-8 : Calculate the mass percentage of NaCl in the solution, if 15.3 g NaCl and 155.09 g water are mixed.

Mass of solute: m_1 =15.3g , Mass of solvent: m_2 = 155.09 g

Mass of solution $m_T = m_1 + m_2$ = 15.3 + 155.09 = 170.39g

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)} \times 100\%$$

$$solute\% = \frac{15.3}{170.39} \times 100\% \qquad solvent\% = \frac{155.09}{170.39} \times 100\%$$

$$solute\% = \frac{1530}{170.39}\ \% \qquad solvent\% = \frac{15509}{170.39}\ \%$$

$$solute\% = 8.98\% \qquad solvent\% = 91.02\%$$

4.9: A solution is prepared by dissolving 27.5 g of methyl alcohol in 175 mL water. Calculate the concentration of the solution in g/L.

$$concentration(g/L) = \frac{175}{1000} = 0.175L$$

$$concentration(g/L) = \frac{m_1}{v_2} = \frac{27.5}{0.175} = 157.14\ g/L$$

4-10 : sample of water is taken from The Habbaniyah Lake . Assume that It contains 8.5 % carbon dioxide . What is the mass of carbon dioxide in 28.6 liters of the Lake water? (Density of the Lake water is 1.03 g/mL.)

$V_{T\,(mL)}$ = 28.6 X 1000 = 28600 mL

$$p(g/mL) = \frac{m_T\ (g)}{V_T\ (mL)}$$

$$1.03 = \frac{m_T}{28600}$$

$$m_T = 29458\ g$$

$$solute\% = \frac{m_1}{m_T}\ x\ 100\%$$

$$8.5\% = \frac{m_1}{29458}\ X\ 100\% \Rightarrow m_1 = 2503.93g$$

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4-11 mass percentage of sugar is 11.5% in juice also juice contain 85.2g sugar, what is the volume of juice?($p_{solution}$ = 1 g/mL)

$$\%solute = \frac{m_1}{m_T} \text{ x } 100\%$$

$$\%11.5 = \frac{85.2}{m_T}\ \% \quad = \quad 740.87 \text{ g}$$

$$p(g/mL) = \frac{m_T\ (g)}{V_T\ (mL)}$$

$$1 = \frac{740.87}{V_T}$$

$$V_T = 740.87\ mL$$

4-12 what are the factors that effected on solubility ?

1- nature of the solute and the solvent.

2- temperature.

3- pressure.

4-13 calculate the mass percentage concentration of the following solution:

a) 10.2g NaCl in 155g of water.

Mass of solute: m_1 =10.2g , Mass of solvent: m_2 = 155 g

Mass of solution $m_T = m_1 + m_2$ = 10.2 + 155 = 165.2g

$$solute\% = \frac{(m_1)}{(m_T)} \text{ x } 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)} \text{ x } 100\%$$

$$solute\% = \frac{10.2}{165.2} \text{ x } 100\% \qquad solvent\% = \frac{155}{165.2} \text{ x } 100\%$$

$$solute\% = \frac{1020}{165.2}\ \% \qquad solvent\% = \frac{15500}{165.2}\ \%$$

$$solute\% = 6.2\% \qquad solvent\% = 93.8\%$$

b) 48.2g sucrose in 498g of water.

Mass of solute: $m_1 = 48.2g$, Mass of solvent: $m_2 = 498\ g$

Mass of solution $m_T = m_1 + m_2$ = 48.2 + 498 = 546.2g

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)} \times 100\%$$

$$solute\% = \frac{48.2}{546.2} \times 100\% \qquad solvent\% = \frac{498}{546.2} \times 100\%$$

$$solute\% = \frac{4820}{546.2}\ \% \qquad solvent\% = \frac{49800}{546.2}\ \%$$

$$solute\% = 8.8\% \qquad solvent\% = 91.2\%$$

c) 0.245g acetic acid in 4.91g of water.

Mass of solute: $m_1 = 0.245g$, Mass of solvent: $m_2 = 4.91\ g$

Mass of solution $m_T = m_1 + m_2$ = 0.245 + 4.91= 5.155g

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\% \qquad solvent\% = \frac{(m_2)}{(m_T)} \times 100\%$$

$$solute\% = \frac{0.245}{5.155} \times 100\% \qquad solvent\% = \frac{4.91}{5.155} \times 100\%$$

$$solute\% = \frac{24.5}{5.155}\ \% \qquad solvent\% = \frac{491}{5.155}\ \%$$

$$solute\% = 4.75\% \qquad solvent\% = 95.25\%$$

4-14 find mass percentage of sugar which contains 309 grams water and 45 grams sugar.

Mass of solute: $m_1 = 45g$, Mass of solvent: $m_2 = 309\ g$

Mass of solution $m_T = m_1 + m_2$ = 45 + 309= 354g

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\%$$

$$solute\% = \frac{45}{354} \times 100\%$$

$$solute\% = \frac{4500}{354}\ \%$$

$$solute\% = 12.71\%$$

4-15 the mass percentage of NaCl in ocean water is 3.5%. how many grams of NaCl can be obtained from 274 grams of ocean water?

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\%$$

$$3.5\% = \frac{m_1}{274} \times 100\%$$

$$3.5\% = \frac{100m_1}{274}\ \%$$

$$m_1 = \frac{3.5 \times 274}{100} = 9.59g$$

4-16 Find the volume of alcohol in milliliters present in the following solution:

1- 480 ml of a solution containing 3.7 % volumetric percentage of the alcohol.

$$solute\% = \frac{(V_1)}{(V_T)}\ x\ 100\%$$

$$3.7\% = \frac{V_1}{480}\ x\ 100\%$$

$$V_1 = \frac{3.7\ x\ 480}{100}$$

$$V_1 = 17.76\ mL$$

2-103 ml of a solution containing 10.2 % volumetric percentage of the alcohol.

$$solute\% = \frac{(V_1)}{(V_T)}\ x\ 100\%$$

$$10.2\% = \frac{V_1}{103}\ x\ 100\%$$

$$V_1 = \frac{10.2\ x\ 103}{100}$$

$$V_1 = 10.5\ mL$$

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3-0.3 L of a solution containing 14.3 % volumetric percentage of the alcohol.

VT = 0.3 x 1000
= 300 mL

$$solute\% = \frac{(V_1)}{(V_T)} \, x \, 100\%$$

$$14.3\% = \frac{V_1}{300} \, x \, 100\%$$

$$V_1 = \frac{14.3 \, x \, 300}{100}$$

$$V_1 = 42.9 \, mL$$

4-17 How many grams of KCl is present in each of the following solutions?

a) 19.7 g solution consists of 1.08 % solute by mass.

$$\text{solute\%} = \frac{(m_1)}{(m_T)} \text{ x } 100\%$$

$$1.08\% = \frac{m_1}{19.7} \text{ x } 100\%$$

$$1.08\% = \frac{100m_1}{19.7} \%$$

$$m_1 = \frac{1.08 \text{ x } 19.7}{100} = 0.21g$$

b) 23.2 kg solution consists of 18.7 % solute by mass.

$$\text{solute\%} = \frac{(m_1)}{(m_T)} \text{ x } 100\%$$

$$18.7\% = \frac{m_1}{23.2} \text{ x } 100\%$$

$$18.7\% = \frac{100m_1}{23.2} \%$$

$$m_1 = \frac{18.7 \text{ x } 23.2}{100} = 0.21g$$

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c) 38 mg solution consists of 12 % solute by mass .

$m_T = 38 \times 1000 = 3800\ g$

$$solute\% = \frac{(m_1)}{(m_T)} \times 100\%$$

$$12\% = \frac{m_1}{3800} \times 100\%$$

$$12\% = \frac{100 m_1}{3800}\ \%$$

$$m_1 = \frac{12 \times 3800}{100} = 456 g$$

4-18 Fill in the blanks:

Substance	Mass of solute	Mass of solvent	Mass of solution	Percentage of solute
A	15.5 g	238.1 g	253.6g	6.11%
B	22.8 g	167.2 g	190.0 g	12%
C	28.8 g	183.3 g	212.1 g	13.57%
D	31.52 g	174.48	206	15.3%

4-19 Fill in the blanks:

Substance	volume of solute	volume of solvent	volume of solution	Percentage of solute
A	2.55 Ml	25.0 mL	27.55 mL	%9.25
B	4.58 Ml	115.9 mL	120.52 mL	%3.8
C	1.38 mL	25.82 mL	27.2 mL	%5.07
D	23.7 Ml	384.9 mL	408.6 mL	%5.8

ملاحظة :
في مثل هذه الاسئلة (املا الفراغات الاتية) والتي نحتاج فيها الى قوانين لاستخراج الحل تكتب القوانين على ورقة الامتحان ولا يتم حذف خطوات الحل (لا تمسحها)

م.م. محمود علي النجم

ثانوية كلية بغداد

ماجستير كيمياء

07711841751

chapter 5

كيمياء المتميزين مع النجم

group IVA



Chapter 5

GROUPS IVA



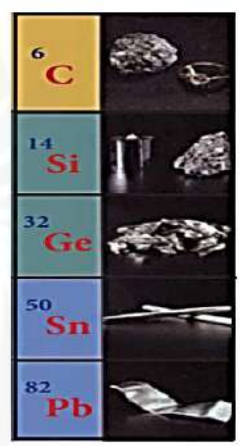
عزيزي الطالب – عزيزتي الطالبة
سوف تكون الترجمة فقط للكلمات التي لم تذكر في الفصول السابقة.
اقرأ المصطلحات الموجودة في نهاية الفصل لتسهل دراستـــه

Group IVA الزمرة الخامسة

Q\ List The elements of IVA group.

Carbon (C), Silicon (Si), Germanium (Ge), Tin (sn), lead (Pb).

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub						



Q\ Fill the blank

Group IVA is more various and numerous in the characteristics of its members than other groups in the periodic table.

Q \ What are the general characteristics of group IVA

1. Carbon is nonferrous (non- metals) , silicon and germanium are metalloid and tin and lead are pure metals.
2. Tin and Lead have the physical characteristics of metals such as high density and thermal and electro conductivity together with bright color and high malleable and ductile prone. قابل للدهرجة
3. The melting and boiling points of group IV elements also decrease as we go from the top to bottom.
4. The elements of this group tend to combine four electrons via making covalent bonds to reach the tetra-oxidation case (+4). بواسطة
5. Silicon and carbon compounds are actually covalent compounds of tetra oxidation.
6. Germanium, tin and lead make ionic and covalent compounds.
7. In the ionic compounds, only two electrons are lost to make Ge^{+2}, Sn^{+2} and Pb^{+2}.
8. The elements of this group whether metalloid or non-metals, have low level of activity.
9. They react with the nonmetals such as oxygen but they need heat to do so.

Q\ The fourth group is characterized as the most diverse group in the characteristics of its elements, why?

Because Carbon is nonferrous, silicon and germanium are metalloid and tin and lead are pure metals.

Q\ Why do melting and boiling points of group IV elements decrease as we go from the top to bottom?

Because of the increase in atomic number of the same group.

Q\ IVA group elements need to gain, lose or combine 4 electrons why?

Because : to reach the stable electron configuration.

Q\ why do elements of IVA group tend to combine four electrons via making covalent bonds to reach the tetra-oxidation case (+4).

Due to the difficulty of gaining or losing four electrons.

Q\ when do Germanium, tin and lead make ionic compounds?

In the ionic compounds, only two electrons are lost to make Ge^{+2}, Sn^{+2} and Pb^{+2}

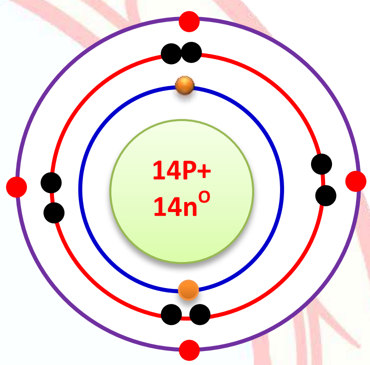
Q\ IVA group elements react with the nonmetals such as oxygen but they need heat to do so, why?

because , they have low level of activity.

Silicon السيليكون

Q / Give the following to the Silicon element: chemical symbol, atomic number, mass number and then draw, the electronic configuration.

chemical symbol	Si
atomic number Z	14
mass number A	28
electronic configuration	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
Number of proton Number of electron	$z = p^+ = e^- = 14$
Number of neutron	n = A – Z n= 28-14 n = 14





Q\ why are most of silicon compounds covalent compounds?

because silicon has four electrons in its outer shell.

Q\ Where does the Silicon element occur?

احتمال تجي فراغات

1. It constitutes more than one quarter of the earth 's crust , approximately <u>28 %</u>
2. It does not occur as a pure free element in nature.
3. It is most widely distributed in rocks as <u>silicon dioxide (SiO_2).</u>
4. It is in the form of <u>quartz and sand.</u>

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Q\ How many forms of silicon element?

1. The first form of silicon is crystallized of <u>dark brown color.</u>

احتمال تجي فراغات

2. The second form is non-crystallized of <u>dark gray color.</u>



Figure 5-3
Types of silicon
A) crystallized
B) non-crystallized

Q\ Which one is more active ? crystallized form or non-crystallized .

The crystallized form is less active than the non-crystallized one. Both forms have a formula similar to diamonds.

Q\ compare between crystallized form and non-crystallized

crystallized	non-crystallized

Q\ How can you prepare Non-crystallized silicon and The crystallized silicon In Laboratory?

Non-crystallized silicon can be produced by heating potassium element in silicon tetra fluoride (SiF_4) according to the following equation:

$$SiF_4 + 4K \xrightarrow{\Delta} Si + 4KF$$

The crystallized silicon can be obtained by melting silicon in aluminum then cooling the solution, and silicon crystals can be separated from the solution.

Q\ How can you prepare Silicon industrially?

Silicon (Si) can be prepared industrially by reducing silica (SiO) using high temperature and carbon or magnesium as a reducing element, as in the following equation:

$$SiO_2 + 2C \xrightarrow{\Delta} 2CO + Si$$

Q\ what are the physical properties of Silicon?

1. Silicon is a metalloid.
2. It is a very rigid element, with a high melting point of approximately (1410 °C).
3. It has a gray color and a metallic luster.
4. It is also a semi conductor.

Q\ Silicon is used in manufacturing of electrical devices and applications and also in computer industry , why?

Q\ Silicon is used in manufacturing solar cells, why?

because It is a semiconductor.

Q\ Fill in the blanks:

1. Silicon does not react with most acids.
2. Silicon is very reactive with chlorine.
3. Silicon is not prone to react at room temperatures. It reacts at (950°C).
4. Silicon and its natural compounds (silica and silicae) are not poisonous.

Q\ Complete these reactions :

Silicon + aqueous solution of sodium hydroxide →

$Si + 2NaOH + H_2O \rightarrow Na_2SiO_2 + 2H_2$

Silicon + with chlorine →

$Si + 2Cl_2 \rightarrow SiCl_4$

Q\ what are the usages of silicon ?

1. it is used in manufacturing of electrical devices and applications and also in computer industry.
2. it is used in manufacturing solar cells.
3. Electronics industry, electrical appliances and in manufacturing solar cells.
4. Metal bars used in different industries.
5. Glass, cement and ceramics industries.
6. Organic silicon materials which are very important commercially in the production of oils and plastics.

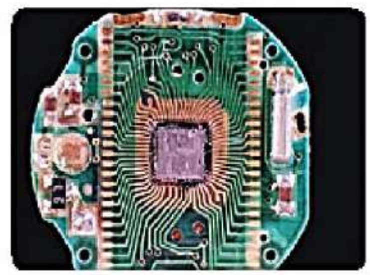


Figure 5 - 4
Use of silicon in integrated circuit industry

Q\ What are the most important of solar cells? H.W

Q\ What are the most important of silicon compounds?

a- Silicon compounds with hydrogen silicon hydrates.

(Silane) These compounds consist of silicon and hydrogen. SiH4 is an example of such compounds.

b- Silicon compounds with oxygen . such as

* silicon dioxide (SiO_2) ** silicates ($-SiO_3$)

c- Silicones

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Q\ How can you prepare silicon hydride?

It is prepared by the reaction of magnesium silicide Mg_2Si with the acids such as hydrochloride as in the following equation:

$$Mg_2Si + 4HCl \rightarrow SiH_4 + 2MgCl_2$$

Q / Prove by formula that silicon hydrides are very effective compounds.

Hydrates are so active compounds. For example silicon (IV) hydride burns spontaneously in atmosphere and forms silicon dioxide and water as in the following reaction:

$$SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$$

Q\ Define: silica or silicon di oxide

Silica: They are highly solid substances and are used in cutting glass and scratching steel. With chemical formula SiO_2.

Q\ Fill in the blanks:

1. Silicon dioxide occurs in nature as pure silica such as quartz and flints.
2. They are highly solid substances and are used in cutting glass and scratching steel.
3. The other form of silicon dioxide (Silica) (SiO_2) is the impure silica such as sand and clay.
4. impure silica contains different quantities of impurities which give it a wide range of different colors.

Q\ Where does the Silicon dioxide occur?

1. Silicon dioxide occurs in nature as pure silica such as quartz and flints.
2. The other form of silicon dioxide (Silica) (SiO_2) is the impure silica such as sand and clay.

Q\ Silica (SiO_2) are used in cutting glass and scratching steel, why?

because They are highly solid substances.

Q\ Silica has wide range of different colors, why?

because It contains different quantities of impurities.

Q\ what are the most important properties of silica ?

a) It is not reactive when reacts with chlorine, bromine, hydrogen most of the acids.
b) It reacts with hydrofluoric acid and bases.
c) It reacts with oxides or metal carbonates by high heating. The resultant compounds are known as (silicates)
d) Silica gel is mainly used as a drier due to its large surface and great ability to absorb water.

عند تفاعل

SiO_2 + اوكسيد الفلز → سليكات الفلز

SiO_2 + هيدروكسيد الفلز → سليكات الفلز + ماء

SiO_2 + كاربونات الفلز → سليكات الفلز + CO_2



Figure 5 - 7 Silica gel as a desiccant factor

Q\ Silica gel is mainly used as a drier, why ?

Due to its large surface and great ability to absorb water.

Q\ Define Silica gel:

Silica gel: is mainly used as a drier due to its large surface and great ability to absorb water.

Q\ Where does the Silicate occur?

Silicate occurs so widely in nature sach as sodium silicate (Na_2SiO_3).

Q\ define water glass or liquid glass.

water glass or liquid glass: It is solution of sodium silicate and its concentrated aqueous solution

Q\ Fill in the blanks:

1- Among types of silicates, sodium silicate is the most widely used.
2- It is soluble in water and its concentrated aqueous solution is called "water glass" or "liquid glass".

Q\ what are usages of water glass or "liquid glass"?

1- It is commonly used in various industrial fields such as providing passive fire protection for textiles and papers.
2- It is also used as a cheap adhesive
3- Cement can be strengthened by mixing it with sodium silicate in order to be used in buildings.

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Q\ Define silicones , Silicon oils

Silicones : These compounds are organic compounds of silicon. They aren't poisonous and are very stable along a very wide range of temperature variation.

Silicon oils: are the most important of these compounds.

Q\ What are usages of the following:

Silicon oil , Silicone rubber and Silicone resin ?

Q \ Copmare between Silicon oils , Silicone rubber and Silicone resin

1- Silicon oils make the surfaces anti moisture and are used to cover the roofs of buildings.
2- Silicone rubber
   a- maintains flexibility at a wide range of temperature variation.
   b- It is used in manufacturing of molds and as a sealing substance in baths and kitchens.
3- Silicone resin is used in electrical insulation and in making construction materials water proof ,too.

INTRODUCTION TO ORGANIC CHEMISTRY

م.م. محمود علي النجم

ثانوية كلية بغداد

ماجستير كيمياء

07711841751

Chapter 6

كيمياء المتميزين مع النجم



Chapter 6

INTRODUCTION TO ORGANIC CHEMISTRY



INTRODUCTION TO ORGANIC CHEMISTRY

Q\ Define the Organic chemistry: غير موجود في الكتاب

Organic chemistry: is one of the branches of chemistry. It study the structure, properties and interactions of compounds and organic matter, i.e, substances containing the carbon element.

Q\why are the Carbon and some of its important compounds in our life

Due to: it principal element in the molecules of living organisms and their nutrition. (غذائها)

It also contributes (يساهم) in several (عديدة) aspects (جوانب) of our daily live (drugs, fragrances (العطور) and paints and in what is known now as Organic Chemistry.

Q\ Why are Organic compounds important in our lives?

because:

1-All forms of basic food materials for human (انسان) and animals, which are: proteins, carbohydrates, oils and animal and vegetable (خضروات) fat.

2- Many natural and synthetic products like cotton, wool, natural and synthetic silk (حرير), paper and plastics.

3- Fuel (وقود) like petroleum, natural gas and wood.

4- Medical drugs as well as vitamins, hormones and enzymes.

من الممكن حفظ مثال واحد مع كل نقطة

Exercise 6-1

Q\ How can you prove presence of carbon in organic compounds experimentally?

The following experiments can be used:

1. When lighting (شمعة) a candle or a piece of paper or (any organic material) carbon dioxide, CO_2 is released (متحرر) which can be found by adding calcium hydroxide solution, $Ca(OH)_2$ which makes it turbid (عكر), whereby calcium carbonates are formed, $CaCO_3$
2. When sugar, an organic substance, is burnted in a test tube, a black substance is formed which is carbon. This indicates that carbon is found in sugar as a component



Burning of sugar

Q\ what are the general features of organic compounds (distinctive features)?

1. All organic compounds contain carbon in their compositions and are subject to decomposition or combustion by heating, particularly if heated to high temperature.
2. Atoms in the organic compounds are bonded by covalent bonds, making them react slowly.
3. Many organic compounds do not dissolve in water but soluble in some organic liquids such as alcohol, ether, acetone and carbon tetrachloride.

Q \ why do Atoms in the organic compounds react slowly?

because the atoms in the organic compounds are bonded by covalent bonds.

Q \ why do not Many organic compounds dissolve in water but soluble in some organic liquids such as alcohol, ether, acetone and carbon tetrachloride. **H.W**

Q\ Full the blank.

1. carbon has an atomic number of 6.
2. the outer shell (valence shell) of carbon atom contains four electrons.
3. each valence bond needs two electrons (one from each atom), carbon atoms bind in the following way by four single bonds with hydrogen in a methane molecule (CH_4).
4. Ethylene has double bond and 4 single bonds Carbon atoms.
5. Acetylene has One triple bond and two single bonds.
6. The chemical of methane molecule is CH_4 ,
7. The chemical of Ethylene molecule C_2H_4
8. The chemical of Acetylene C_2H_2

احتمال الكلمات الي باللون
الماروني هي الفراغ
احتمال الي باللون الاخضر

Q\ There are thousands of organic compounds in nature and can also be synthesized as well. Why?

carbon atoms' ability to bond with each other to form open or closed chains (rings). These chains include single, double or triple bonds between carbon atoms or other atoms.

Q\ define the following:

Hydrocarbons: is compound containing carbon and hydrogen only.
either saturated or unsaturated.
such as Methane CH_4, Ethylene C_2H_4, Acetylene C_2H_2

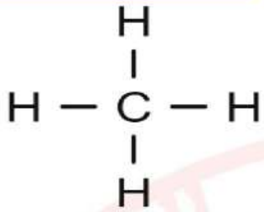
Alkanes: one types of saturated hydrocarbon compounds organic compounds contain single valence bonds. such as Methane CH_4

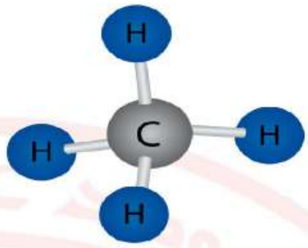
Alkenes: one types of unsaturated hydrocarbon compounds organic compounds contains double bonds between carbon atoms.
such as ethylene molecule (C_2H_4)

Alkynes: one types of unsaturated hydrocarbon compounds organic compounds contains triple bond between two carbon atoms.
such as Acetylene molecule (C_2H_2)

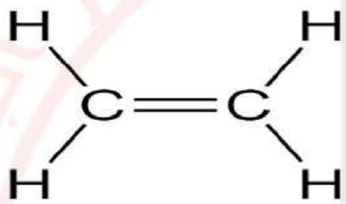
Q \ Draw the structural formula of the following molecules:

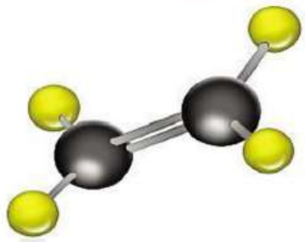
1- Methane molcule





2- Ethylene molcule

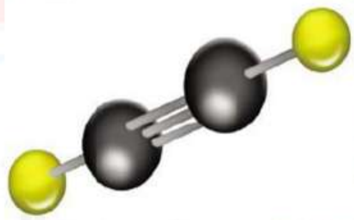




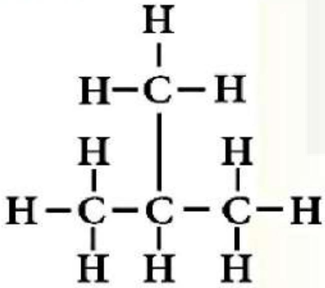
3- Acetylene molcule



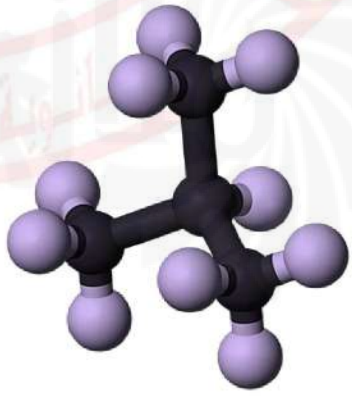
acetylene



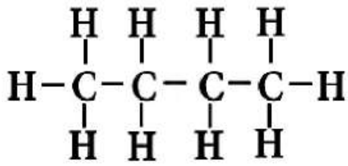
4- Organic compound (branched chain)



Organic compound
(branched chain)
Isobutane



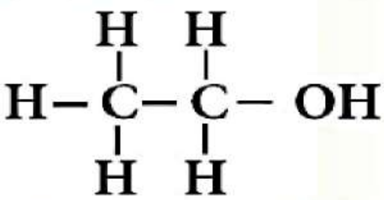
5- Organic compound (unbranched chain)



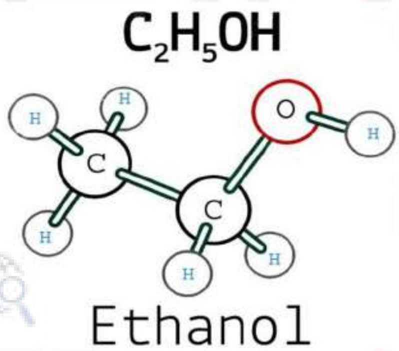
Organic compound
(unbranched chain)
Butane



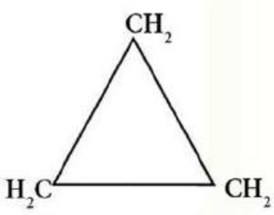
6- Organic compound (containing oxygen element)



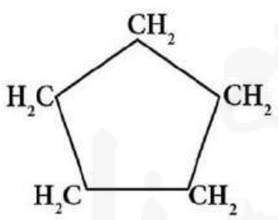
Organic compound
containing oxygen element
(Ethyl alcohol)



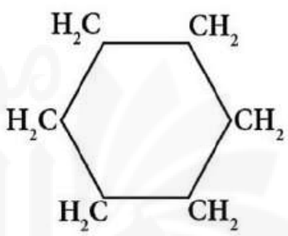
7- Cyclic Organic compound



Cyclic organic compound
in triangular shape
(Cyclopropane)



Cyclic organic compound
in pentagon shape
(Cyclopentane)



Cyclic organic compound
in hexagonal shape
(Cyclohexane)

Methane

Q\ Define Methane

Methane: Its molecular formula is CH_4 whereby a carbon atom is bonded with 4 Hydrogen atoms in a single bond.

Q\ where does methane exist in nature?

1- It is found in large amounts as natural gas which accompanies crude petroleum.

2- It is emitted from cracks of coal mines.

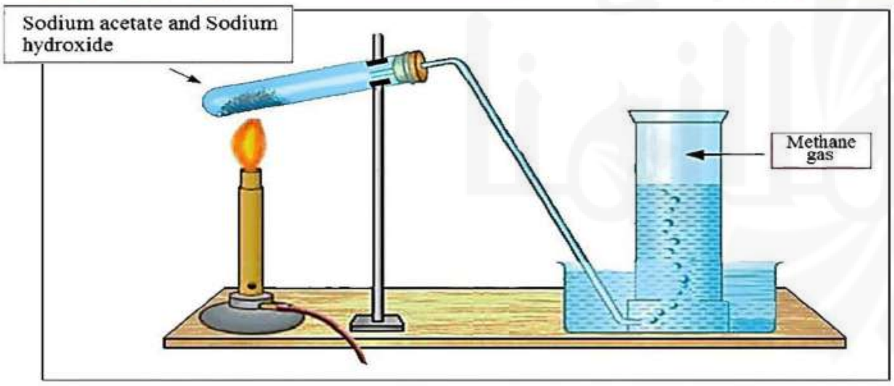
3- It is also formed when organic materials are decomposed in stagnant waters of ponds and swamps.

Q\ Prepare the Methane Gas in Laboratory.

Methane is prepared by using the apparatus below.

*Sodium acetate is heated at high temperature along with sodium hydroxide or calcium hydroxide (because the mixture will have little effect on glass and ensures higher melting point for sodium hydroxide) in a beaker.

*The resulting gas is collected by removing the water further down.



الرسم والمعادلة حيل مهم ذكرها

$$CH_3COONa + NaOH \xrightarrow{\Delta} CH_4\uparrow + Na_2CO_3$$

Sodium acetate   Sodium hydroxide   Methane   Sodium carbonate

Q\ Sodium acetate is heated at high temperature along with sodium hydroxide or calcium hydroxide. why?

because the mixture will have little effect on glass and ensures higher melting point for sodium hydroxide

Q\ what are the Physical Properties of Methane gas?

1. Colorless.
2. Highly insoluble in water.
3. Flammable, smokeless flame, releasing carbon dioxide CO_2 and water vapor and energy, as in the following equation:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + Energy$$

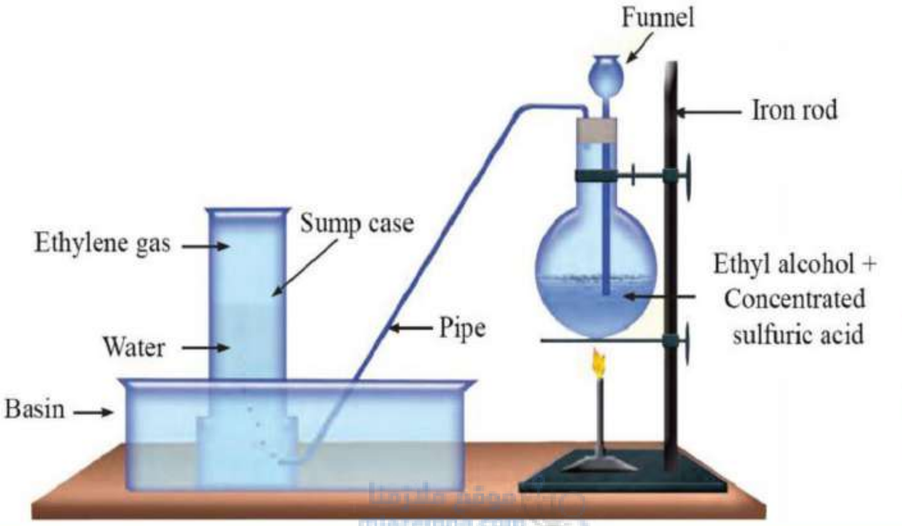
Ethylene

Q\ Define Ethylene

Ethylene: It is one kind of unsaturated hydrocarbons which are called "Alkenes". It has the molecular formula of C_2H_4 in which two carbon atoms combine with each other through double bond.

Q\ Prepare the ethylene gas in laboratory and draw the apparatus.

Ethylene can be produced by heating ethyl alcohol C_2H_5OH, with sufficient amount of concentrated sulfuric acid up to 170 °C as in the figure below.



الرسم والمعادلة حيل مهم ذكرها

$$\underset{\text{Ethyl alcohol}}{C_2H_5OH} \xrightarrow[170°C]{\text{Concentrated } H_2SO_4} \underset{\text{Ethylene}}{C_2H_4 \uparrow} + \underset{\text{Water}}{H_2O}$$

Q\ Why are you adding sulfuric acid when we are preparing ethylene?

The sulfuric acid removes water molecule from the of alcohol.

Q\ What are the physical properties of ethylene gas?

1. **It is colorless and insoluble in water.**
2. **It burns with a smoky flame producing carbon dioxide and water.**

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

3. **It reacts with the red bromine water and removes its color.**

Q\ How can you distinguish between ethylene and gaseous methane.

Ethylene reacts with the red (Br) water and removes its color.

Methane doesn't react with the red (Br) water and color doesn't disappear.

Ethylene + red bromine water → red color disappears

Methane + red bromine water → red color doesn't disappear



Ethylene gas is used to ripen tomato

Q\ deifne Acetylene

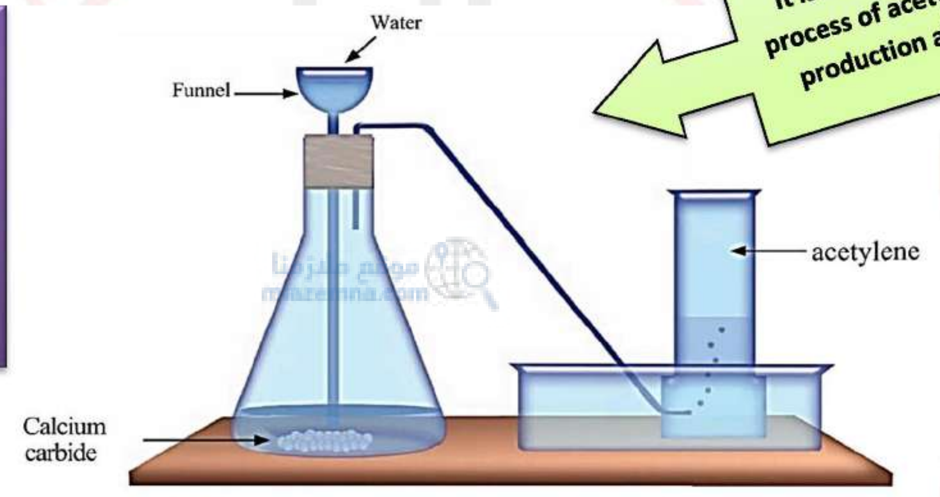
Acetylene: It is a hydrocarbonic compound with the molecular formula of (C_2H_2) in which the two carbon atoms combine with each other in triple covalent bonds. It is an example of the unsaturated hydrocarbons called "Alkynes".

Q\ Prepare the Acetylene gas in laboratory and draw the apparatus.

By putting calcium carbide in an erlenmeyer flask. Water is added very slowly and gradually using a tube. The reaction which happens immediately produces the gaseous acetylene which can be collected from the bottle by removing water downward.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

الرسم والمعادلة حيل مهم ذكرها



It is an industrial process of acetylene production also.

Q\ What are the properties of Acetylene?

1. It is a colorless gas with a bad smell. ((It smells like garlic)).
2. It is insoluble in water.
3. Combustion of acetylene forms a smoky flame.
4. It burns with oxygen gas in making a faded blue flame and high temperature:

$$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O + Energy$$

5. It reacts with the red bromine water and removes its color.

Q\ How can you distinguish between acetylene and gaseous methane.

Ethylene reacts with the red (Br) water and removes its color.

Methane doesn't react with the red (Br) water and color doesn't disappear.

- Acetylene + red bromine water → red color disappears.
- Methane + red bromine water → red color doesn't disappear.

Q\ what are the usages of Acetylene?

1- The mixture of the Acetylene gas and oxygen is used to produce the oxyacetylene for cutting or welding metals.

8- It is used as a raw material in the production of rubber,plastics and acetic acid.

Q\ Define oxyacetylene

H . W

Oxyacetylene : …………………………………………………………………………………….
…………………………………………………………………………………….. .

Alcohol

Q\ Define : Alcohol , Ethanol (Ethyl Alcohol)

Alcohol : It is an Arabic word from which the Latin word "Alcohol'is derived. It was known long time before and was produced then by fermenting molasses, dates or grapes in isolated air from air

Ethanol (Ethyl Alcohol) : it is one types of alcohol , It has chemical formula C_2H_5OH.

Q\ How can you prepare Ethyl alcohol By the effect of zymase enzyme (normal method)(old method)?

1- fermenting molasses, dates or grapes in isolated air from air
2- sugar is converted into simpler sugar By the effect of zymase enzyme
3- simpler sugar is converted into carbon dioxide and ethanol by virtue of enzyme.
4- Alcohol is then separated from its aqueous solution by the process of distillation.

$$\text{Simple sugar} \xrightarrow{\text{zymase enzyme}} \text{Ethyl alcohol Carbon dioxide}$$

Q\ How can you prepare ethanol or ethyl alcohol industrially?

by oil products through the reaction of gaseous ethylene C2H4 with water with the existence of concentrated sulfuric acid and other factors such as heat and pressure.

$$\underset{\text{Ethylene}}{C_2H_4} + \underset{\text{Water}}{H_2O} \xrightarrow{\text{Concentrated } H_2SO_4} \underset{\text{Ethanol or ethyl alcohol}}{C_2H_5OH}$$

Q\ what are the properties of Ethanol (Ethyl Alcohol)?

1. It is a liquid with a boiling point lower than the boiling point of water. Its freezing point is very low.
2. It is a volatile liquid with a very distinguishing smell.
3. It is an active solvent to many organic substances.
4. Complete combustion of ethanol produces a faded blue flame and forms carbon dioxide CO_2 and water vapor.

Q\ What are Uses of Ethanol (Ethyl Alcohol)?

1. As a raw material in many industries especially cosmetics, commercial rubber, ink, many types of paints and perfumes.
2. It is used in the production of alcoholic beverages and drugs.
3. It is used as a motor fuel through mixing it with other oil products.
4. It is poisonous but it is used as a sterilizer by mixing it with some iodine.
5. Ethyl alcohol is very cheap for industrial purposes.

Q\ Define denaturated alcohol (methylated spirito)

denaturated alcohol: It is undrinkable as some poisonous substances like methyl alcohol are added to it and by then known as denaturated alcohol (methylated spirito).



Q\ some substances (methyl alcohol) are added to ethyl alcohol, why?

To make its color different from pure ethyl alcohol.

Q\ what are the effects of Ethyl Alcohol on Human Beings?

1. Drink alcohol disturbs the consistency between the muscular and nervous systems.
2. Change in mood, recognition and feelings are noted.
3. Slow down the functions of nerve cells in the nervous system.
4. Addicted people go to hospitals and health institution
5. Sause social consequences.
6. People addicted to alcohol behave strangely and sometimes dangerously.

Q\ Some governments impose high taxes, why?

To reduce alcohol consumption and to eliminate its social, health and economic damages.

Acetic Acid CH_3COOH

Q\ How can you prepare Acetic Acid (CH_3COOH) industrially?



Acetic acid is produced industrially by the reaction of acetylene with water using sulfuric acid and other facilitating factors. A chain reaction occurs and finally produces acetic acid.

Q\ what are the Properties of Acetic Acid?

1-It is a liquid at room temperature.

2-It is a volatile compound.

3-It reacts with sodium hydroxide to form water soluble sodium acetate.

5- It can te mixed with water at any rate.

Benzene (C_6H_6)

Q\ How do you extract Benzene (C_6H_6) ?

Benzene can be extracted from coal tar which is one of the petrol products and is fugitive (vapor quickly).



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Q\ define Benzene

Benzene: is a hydrocarbonic compound consisting of carbon and hydrogen and is the simplest compound in the group of hydrocarbons which are called "Aromatic Hydrocarbons" . it has chemical formula (C_6H_6)

Q\ Benzene is classified into aromatic hydrocarbons, why?

because of their distinctive smells

Q\ What are the important properties of benzene?

1. Benzene vapors very quickly and boils at (80°C).
2. It is not soluble in water
3. Its complete combustion results in a very smoky flame because of the high percentage of carbon.

Q\ What are the usages of Benzene ?

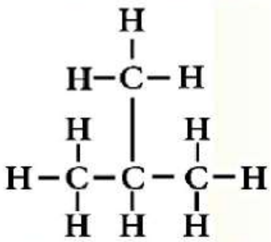
1. It is used as an important industrial solvent to paints and many important industrial products.
2. It is also used in the production of insecticides, nylon, modern detergents.

CHAPTER QUESTIONS 06

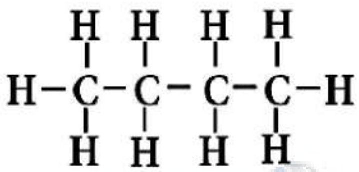
6.1 How can methane gas be produced in laboratory draw shape of equipments and write the reactions?

جواب السؤال صفحة 8

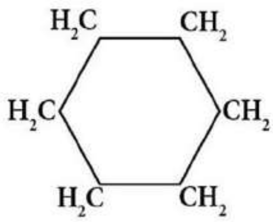
6.2 Give example about following terms: Give example about



Organic compound (branched chain) Isobutane



Organic compound (unbranched chain) Butane



Cyclic organic compound in hexagonal shape (Cyclohexane)

Branched chain | **unbranched chain** | **cyclic chain**

6.3 choose the most appropirate of the brackets that complete the following expressions:

a. All organic compounds contain one of following elements in their composition (hydrogn , oxygen , nitrogen , sulfur , carbon)

b. The bond between two carbon atoms in the saturated hydrocarbons is a

a) Single b) double c) triple

c. The gas that is found in large amounts in natural gas is ………………….

Methane. Ethylene. Acetylene

d. In acetylene; two carbon atoms are bound each other by …………………

a) Single covalent bond b) Two covalent bonds c) Three covalent bonds

6.4 How can be produced acetylene gas in laboratory, draw shape of equipment and write the reactions?

جواب السؤال صفحة 12

6.5 What are the general features of the organic compound?

جواب السؤال صفحة 3

6.6 Write balance equations of the following.

1) Heating of Sodium acetate and sodium hydroxide

$$\underset{\text{Sodium acetate}}{CH_3COONa} + \underset{\text{Sodium hydroxide}}{NaOH} \xrightarrow{\Delta} \underset{\text{Methane}}{CH_4\uparrow} + \underset{\text{Sodium carbonate}}{Na_2CO_3}$$

2) Burning of Methane, ethylene, acetylene gases in air

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + Energy$$

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

$$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O + Energy$$

3) Rcaction of water with calcium carbidc.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

6.7 Explain the effect of normal alcohol on the humans body after drinking it?

جواب السؤال صفحة 15

6.8 What is passive alcohol Sperto.

denaturated alcohol: It is undrinkable as some poisonous substances like methyl alcohol are added to it and by then known as denaturated alcohol (methylated spirito).

6.9 1. Compare the methane, ethane and acetylene gases about.

Compare	Methane	Ethane	Acetylene
Color & odor	colorless	colorless	colorless
Solubility in water	Highly insoluble	insoluble	insoluble
Burning in air in normal form	اكتب معادلة الاحتراق	اكتب معادلة الاحتراق	اكتب معادلة الاحتراق
Reaction with red bromine solution	doesn't react with the red bromine	react with the red bromine	react with the red bromine

2. What is used with acetylene gas to produce strong flame?

Oxygen gas with acetylene gas to produce strong flame

6.10 What is the importance of benzene?

1. It is used as an important industrial solvent to paints and many important industrial products.
2. It is also used in the production of insecticides, nylon, modern detergents.

6.11 What is the methane gas that is reflected in each of the following observations

a. The gas is collected when it is prepared by pushing the water down.

Methane doesn’t soluble in water

b. Gas does not react with bromine.

Methane saturated hydrocarbon compounds organic compounds

c. The gas burns with a smokeless flame.

Methane saturated hydrocarbon compounds organic compounds

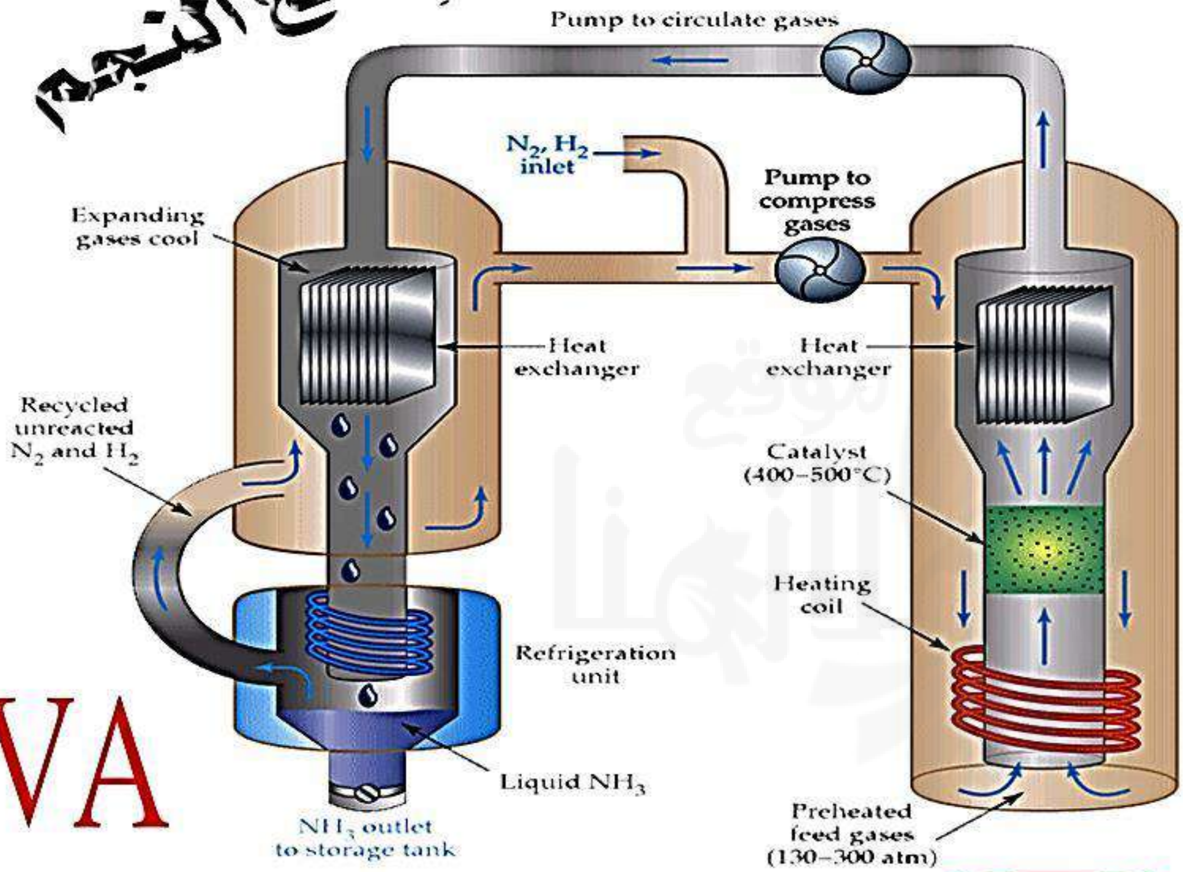
6.12 Both acetylene and gasoline are ignited with an smoke flame, what do you deduce from this observation.

Acetylene unsaturated hydrocarbon compounds organic compounds

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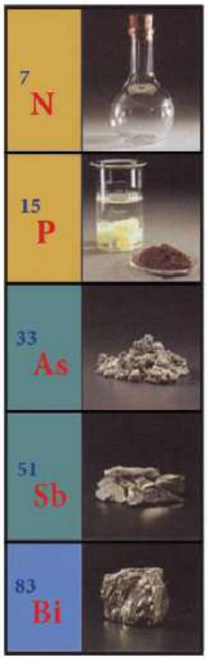
Chapter 7

كيمياء المتميزين مع النجم



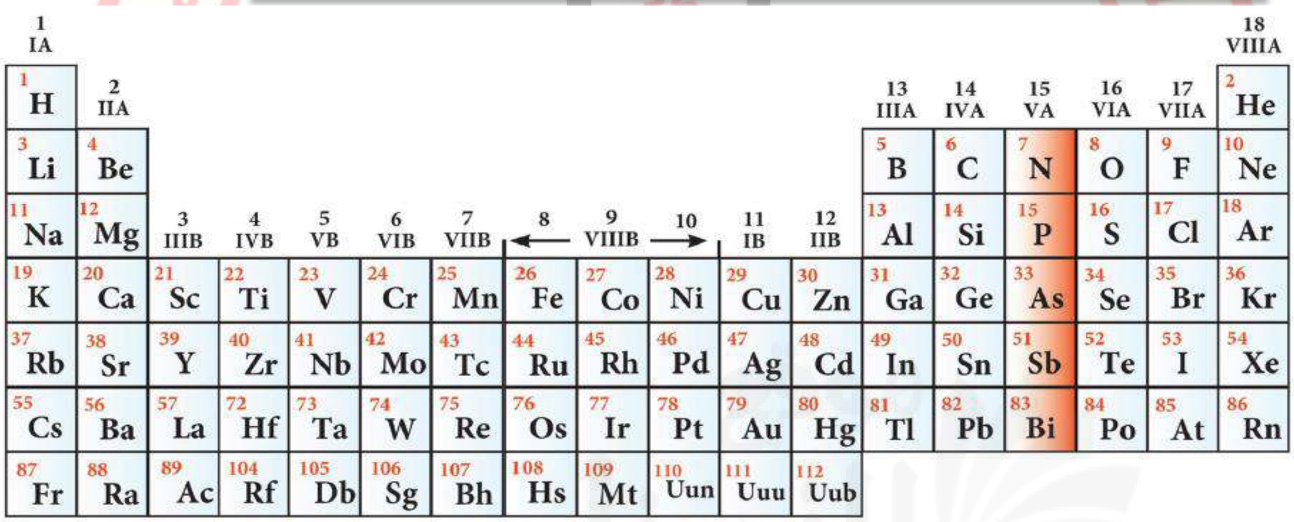
VA

النجم في الكيمياء YouTube



Chapter 7

ELEMENT OF VA GROUP



عزيزي الطالب – عزيزتي الطالبة

سوف تكون الترجمة فقط للكلمات التي لم تذكر في الفصول السابقة.

Group VA

Q\ What are the elements of group VA :

VA (group five) consists of Nitrogen (N), Phosphorus (P), Arsenic (As), Antimony (Sb) and Bismuth (Bi).

Q\ Why are nitrogen and phosphorus in the same group?

Because they have five electrons in their outer shells.

Q\ What are the characteristics of group VA?

1. (Nitrogen and phosphorus) are nonmetals, Arsenic and antimony are metalloid, (bismuth) is metal.
2. Nitrogen is gaseous, the rest of the elements are solids in normal conditions.
3. Phosphorus and nitrogen have the propensity to form covalent compounds, bismuth and arsenic form ionized compounds.
4. The acidic and basic properties of the elements oxides also vary from being acidic (phosphorus) to basic (bismuth).

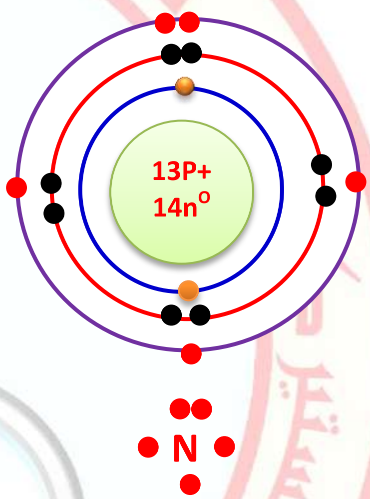
Q\ Complete:

- Elements of VA group form less than 0.2 % of the Earth's crust.

Nitrogen النتروجين

Q / Give the following to the Nitrogen element: chemical symbol, atomic number, mass number and then draw the electronic configuration.

chemical symbol	N
atomic number Z	7
mass number A	14
electronic configuration	$1s^2\ 2s^2\ 2p^3$
Number of proton Number of electron	$z = p^+ = e^- = 7$
Number of neutron	n = A – Z n= 14 - 7 n = 7



Q\ Where does the Nitrogen element occur?

1. Nitrogen constitutes 78 % of the Earth's atmosphere.
2. It is found in some compounds (such as fertilizers (أسمدة) and food)

Q\ Define Azote or the Lifeless

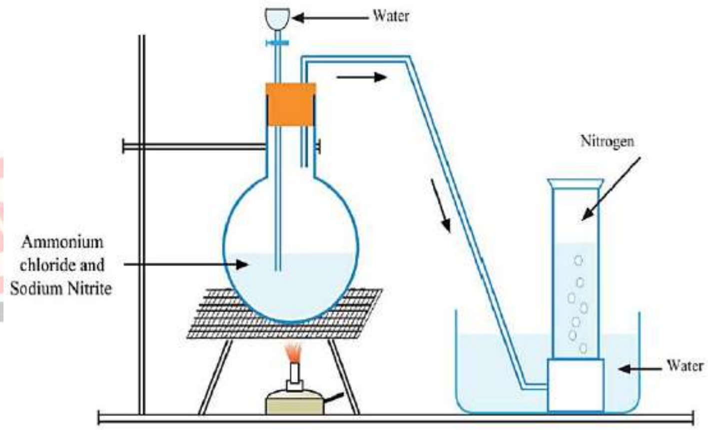
Azote (ازوت): it is nitrogen gas, which means in Latin "the Lifeless" **because** it is mostly an inert (خامل) gas in standard conditions.

Q\ What are the usage of nitrogen gas?

Nitrogen compounds are very important in food, fertilizers and explosive (المتفجرات) industries.

Q\ Explain the Preparation of Nitrogen in Laboratory.

A mixture of ammonium chloride (NH_4Cl) and Sodium Nitrite $NaNO_2$ is put to a heating source with some water to لمنع **prevent** any possibility of explosion occurrence.



$$NH_4Cl + NaNO_2 \xrightarrow[\Delta]{H_2O} NaCl + NH_4NO_2$$

$$NH_4NO_2 \xrightarrow{H_2O} 2H_2O\uparrow + N_2\uparrow$$

Q\ Explain the Industrial Preparation of nitrogen gas.

we can be produce nitrogen industrially by the following steps :

1. The fractional التجزيئي distillation التقطير of liquid air, which must have no carbon dioxide (CO_2).
2. Nitrogen distills يتقطر first leaving oxygen behind **because** the boiling point of nitrogen (-198°C) is lower than the boiling point of oxygen (-183°C).
3. **Remove the remaining oxygen by passing the gas through heated copper fillings, which react with oxygen to form (CuO).**

Q\ Complete:

1. Large quantities of gaseous nitrogen can be industrially produced by the fractional distillation.
2. boiling point of nitrogen (-198°C) is lower than the boiling point of oxygen (-183°C).
3. In industrial process of nitrogen, remove the remaining oxygen by passing the gas through heated copper fillings, which react with oxygen to form (CuO).

Q\ What are the physical Properties of Nitrogen gas?

> **Do you know**
> There is other diatomic molecule like H_2 , Cl_2 F_2 and O_2

1. Colorless.
2. Odorless.
3. Tasteless.
4. It has the form of diatomic molecule (N_2) at room temperature.
5. It is less soluble in water.
6. Almost inactive in normal conditions.

Q\ What are the Chemical Properties of nitrogen?

1- Heating nitrogen leads to direct interaction between nitrogen and magnesium, lithium and calcium.

2- When mixed with oxygen and the mixture is put under a spark (شرارة), nitrogen produces nitrogen oxides (NO and NO_2).

3- Heating nitrogen with gaseous hydrogen under high pressure and with an appropriate (مناسب) catalyst produces ammonia (Haber - BOSCH process), according to the following equation:

$$N_2 + 3H_2 \xrightarrow[\text{Catalyst}]{\Delta \text{ high pressure}} 2NH_3$$

المحفز

Q\ Define Catalyst

إنتاج

Catalyst : A substance that changes the speed or yield of a chemical reaction without being consumed (مستهلك) or chemically changed by the chemical reaction.

Q\ What are the Usags of Nitrogen?

1. It is used to produce ammonia industrially.
2. It is the most important use of nitrogen due to the vital (حيوي) importance of this substance in the production of fertilizers and in the production of nitric acid (Ostwald process).
3. It is used in cooling and freezing food products by putting the products into the liquid nitrogen gas.
4. The liquid nitrogen is used in the petroleum industries. It is used to cause an increase in the pressure in the petrol producing wells to push the petrol up the wells.

5- It is used as an inert (خامل) agent (عامل) in containers and tanks of flammable materials.

Q\ Produce ammonia industrially, it is the most important use of nitrogen, why?

Due to the vital importance of this substance in the production of fertilizers and in the production of nitric acid (Ostwald process).

Q\ The liquid nitrogen is used in the petroleum industries, why?

It causes an increase in the pressure in the petrol producing wells to push the petrol up the wells.

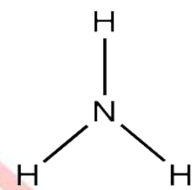
Q\ What are the number of electrons in outer shell of Nitrogen atom ?

It has **five** electrons in its outer shell.

Q\ What are the number of covalent bonds in the Ammonia molecule and the Nitrogen molecule?

1. Single bond in the molecule of ammonia (NH_3)
2. Triple bond in the molecule of nitrogen (N_2).

$N \equiv N$



Q\ What are The most important compounds of nitrogen?

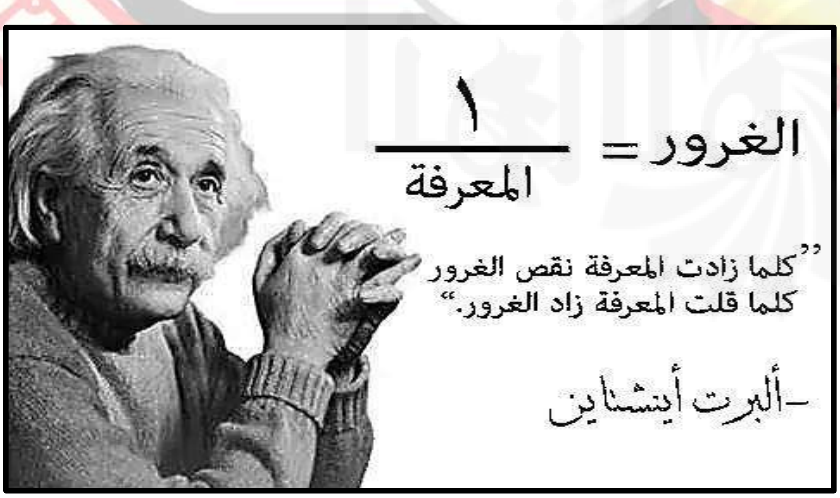
1- Ammonia NH_3 2- nitric acid HNO_3

Q\ Define Ammonia

Ammonia: It is one of the important compounds of nitrogen and hydrogen. it has chemical formula NH_3.

Q\ Where does the ammonia occur?

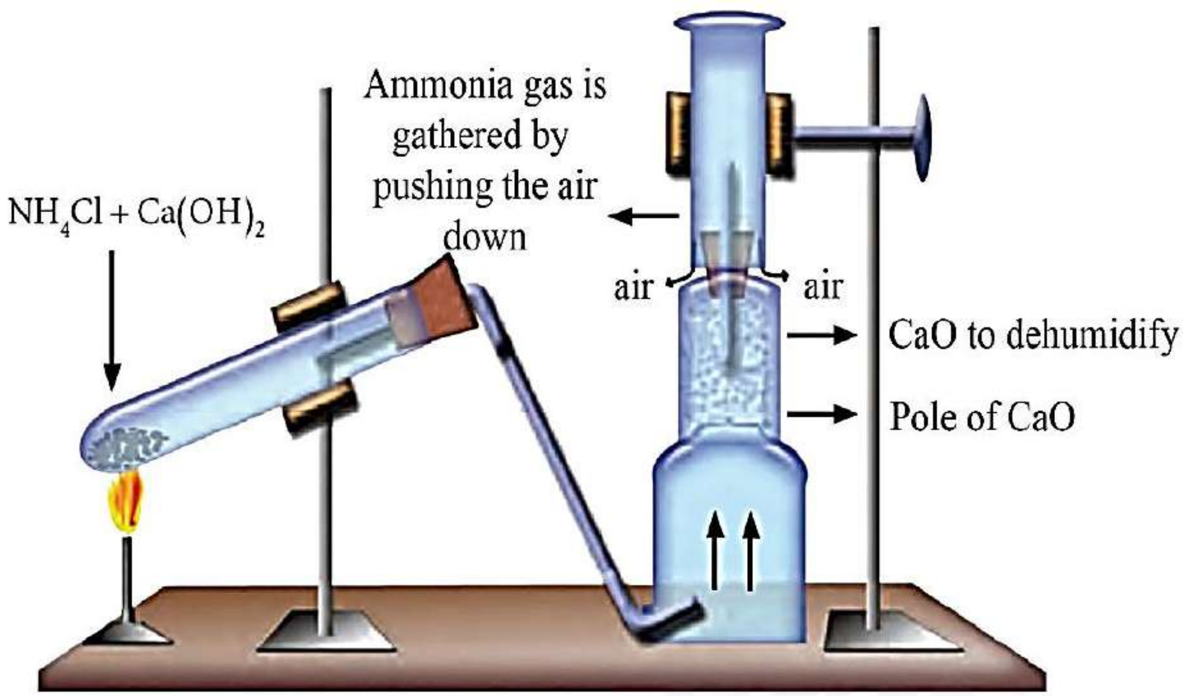
1. It occurs in nature because of the process of decay (تحلل) of animals and plants upon death.
2. Ammonia occurs in soil in the form of ammonium salts.



Q\ How can you Prepare Ammonia in Laboratory?

Gaseous ammonia can be produced in the laboratory by heating the salt of ammonium chloride with calcium hydroxide, as in the following equation:

$$2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3$$



Q\ Why does ammonia collected by downward removal of air?

Because the gas ammonia is lighter than air.

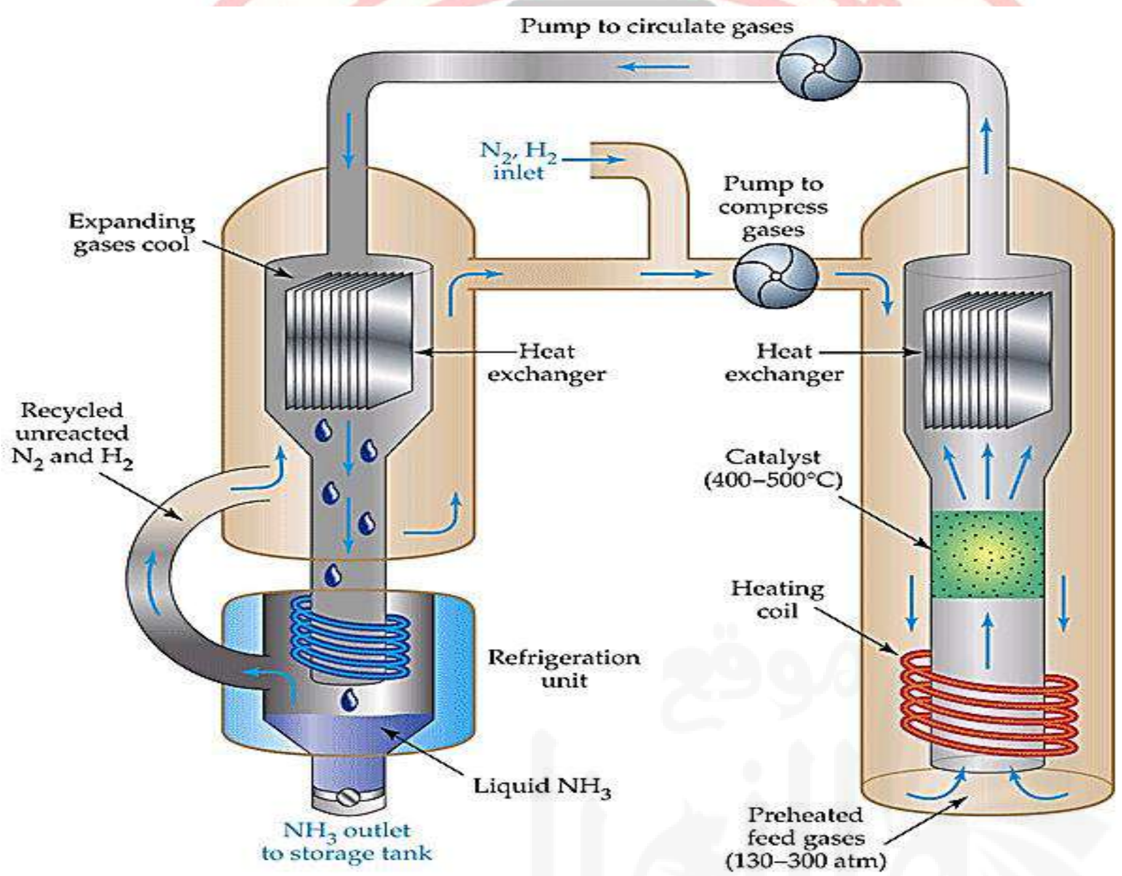
Q\ Why does ammonia pass onto pole of calcium oxide?

To remove any moisture with the gas.

Q\ Explain the Industrial Preparation of Ammonia.

Quantities of ammonia can be produced industrially by **Haber-BOSCH** by the direct combination of nitrogen and hydrogen as in the equation and figure below:

$$N_2 + 3H_2 \xrightarrow[\text{Catalyst}]{\Delta \text{ high pressure}} 2NH_3$$



Q\ Define Haber Process.

Haber Process: An industrial process used for producing ammonia from nitrogen and hydrogen by combining them under high pressure in the present of an iron catalyst.

Q\ What are the physical Properties of Ammonia?

رائحة حادة

1. Ammonia is a colorless gas with a characteristic pungent smell.
2. It is lighter than air .
3. It has strong propensity (ميل) to be soluble in water .
4. It can be liquidized at room temperature with 8 - 10 atm pressure .
5. The boiling point of liquid Ammonia is (- 33.5°C) under the normal atmospheric pressure .
6. It vapors at high temperature.

Q\ What is the aqueous solution of Ammonia?

The aqueous solution of Ammonia (NH_4OH).

If this aqueous solution is heated or exposed (معرض/مكشوف) to air, the solution loses NH_3 gas .

Q\ Why is ammonia used in refrigeration and ice production?

Because, it evaporates at high temperature.

ليس الجمال بأثواب تزيننا

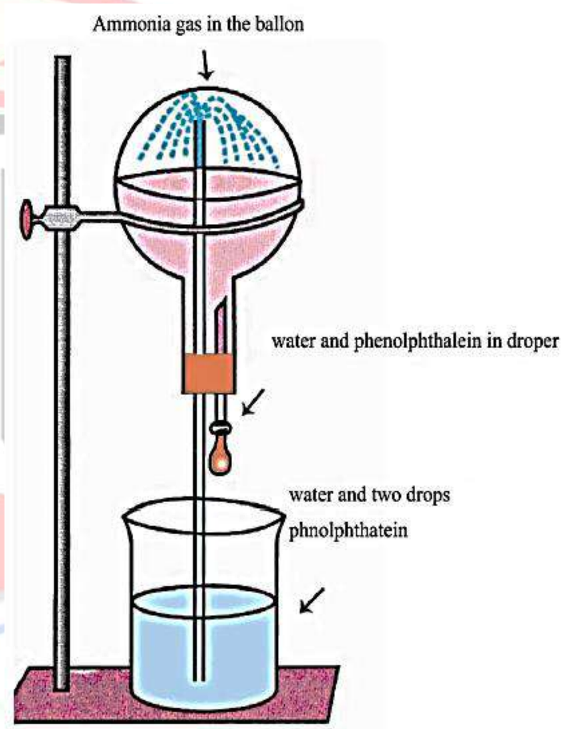
الجمال جمال العلم والأدب

النافورة تجربة

Q\ Expline Fountain experiment.

The experiment consists:

1. Half of glass is filled with water with two drops of phenolphthalein.
2. It consists of a round bottom flask مزودة provided with a rubber cover with two holes.
3. A long glass tube goes through one of these two holes down to the bottom of the flask .
4. A dropper tube goes through the other hole of the cover .
5. The flask is filled with dry ammonia gas and then turned رأسا على عقب **upside down** on the Water glass.



6. The dropper tube is used to add some water drops with the color less phenolphthalein .
7. The gas reach with the Water and starts to dissolve .
8. This process changes the pressure inside the flask and the water pushes from the glass to the flask as a fountain.
9. The solution becomes pink - red because of it's أساسيا basically ammonia solution is act as a base).

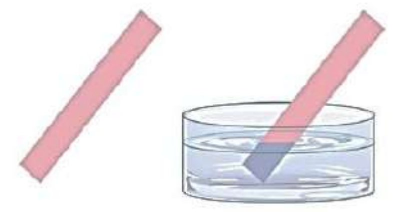
تمتع بمشاهدة التجربة على قناة
النجم في الكيمياء
على اليوتيوب

Q\ Ammonia solution turns the red litrus paper into blue, why?

Q\ The ammonia solution (phenolphthalene) is colored in red, why?

Because, the aqueous solution of Ammonia is base (NH_4OH).

$$NH_3 + H_2O \longrightarrow NH_4OH$$ للاطلاع فقط



Bases turns red litmus to blue color

Q\ Complete the following:

Ammonia molecule is chemically <u>stable</u> , yet it can release <u>nitrogen</u> and <u>hydrogen</u> when you pass gas on a <u>hot metal</u> surface , or when passing an <u>electric spark</u> through the gas .

Q\ Complete by equation:

Ammonia gas is flammable in an atmosphere of oxygen.

مهم

$$4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$$

Q\ Explain the test of Ammonia.

by react ammonia with hydrogen chloride , it produces white dense vapor (كثيف) which is ammonium chloride .

$$\underset{\text{Ammonia}}{NH_{3(g)}} + \underset{\text{Hydrogen chloride}}{HCl_{(g)}} \rightarrow \underset{\text{Ammonium chloride}}{NH_4Cl_{(g)}} \uparrow$$

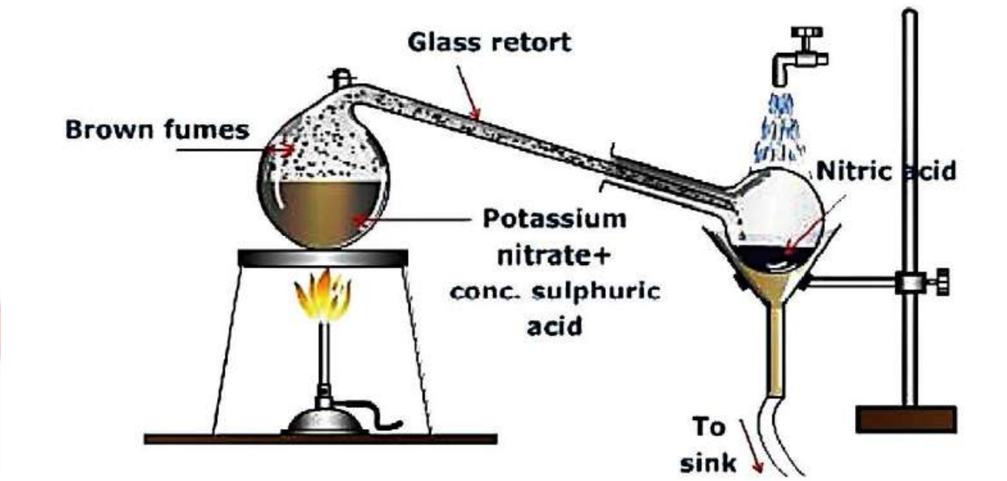
حامض النتريك

Q\ Define Nitric acid

Nitric acid: It is the most important oxygenated acids of nitrogen,which has a molecular formula HNO_3 .

Q\ Explain Preparation method of Nitric Acid in Laboratory.

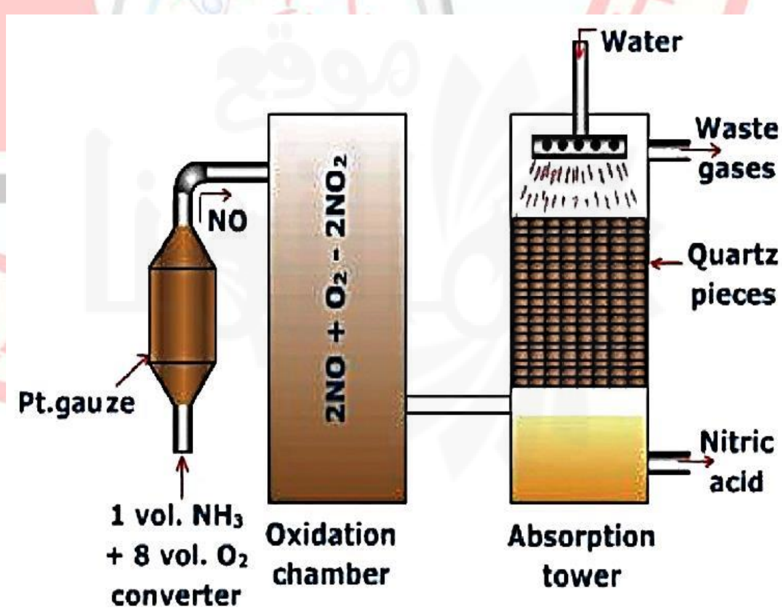
It is prepared by heating a mixture of Potassium nitrate salt with sulfuric acid in
مقطرة معوجة
the glass retort, and the nitric acid vapor resulting from the interaction is
وعاء
condensed in a water-cooled vessel the interaction.



$$KNO_3 + H_2SO_4 \xrightarrow{\Delta} KHSO_4 + HNO_3$$

Q\ Explain Preparation method of nitric acid Industrially.

The acid can be prepared in
تجارية كميات
commercial quantities by
اوستلد
method of Ostwald whereby ammonia is oxidized in air, platinum acts as a catalyst.





Scientist
Fredrick Wilhelm Oswald

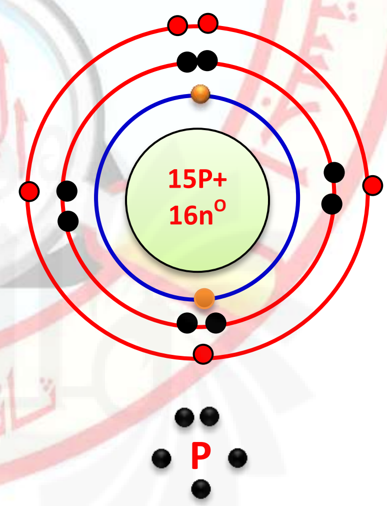
Q\ What are the Properties of Nitric acid?

1. Pure acid is colorless .
2. It has odorous fumes (عطرة / أبخرة)
3. The color of the impure acid is yellow
4. It is completely dissolving in water forming a mixture of (68%)
5. It boils at 120.5 °C

Phosphorus الفسفور

Q / Give the following to the Phosphorus element: chemical symbol, atomic number, mass number and then draw the electronic configuration.

Chemical symbol	P
Atomic number Z	15
Mass number A	31
Electronic configuration	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
Number of proton Number of electron	$z = p^+ = e^- = 15$
Number of neutron	$n = A - Z$ $n = 31-15$ $n = 16$



Q\ Where does the Phosphorus element occur?

1. It is not found freely in nature.
2. It is found in nerve cells, bones and cell cytoplasm.
3. It is extensively (على نحو واسع) found various minerals (Apatite ores) (الاباتيت / خام)

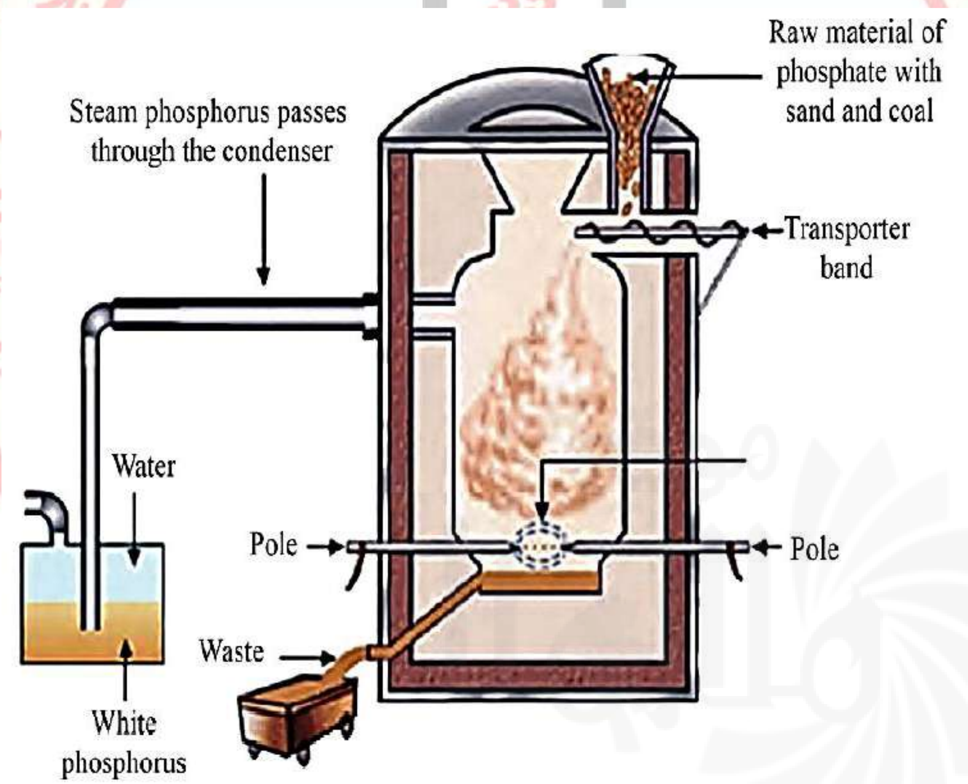
Q\ Define Apatite

Apatite : It is impure form of calcium phosphate is important source of this element.

Q\ Explain Industrial Production of Phosphorous.

Phosphorous is normally produced by heating Calcium Phosphate $Ca_3(PO_4)_2$ with the sand (SiO_2) and carbon **C** in an electrical oven at high temperature , air-tight (محكم) , as in the following equation :

$$2Ca_3(PO_4)_2 + 6SiO_2 + 10C \xrightarrow{1500\ ^\circ C} 6CaSiO_3 + 10CO + P_4$$



The resulting phosphorous white

Q\ Why does not need to prepare phosphorus in laboratory?

تمثل
Because apatite ores represent the basic source for commercial phosphorus production with high purity.



Q\ Why is phosphorus casting done underwater?

Because of:

1. It is the low temperature of flammability.
2. It is fast integration with oxygen.
3. It is high flammability in air.

Q\ When producing phosphorus, CO is produced instead of CO_2, why?

Because the electric oven at high temperature and air-tight.

Q\ What is the Properties of Phosphorous?

شكل شمعي
1. Phosphorous is normally white (yellowish) having a waxy form.

شفاف
2. Pure Phosphorous, it is solid colorless and transparent.
3. White Phosphorous is more active than red phosphorous under normal temperatures.

Q\ What is the Properties of white phosphorous?

1- White phosphorous glows in the dark, looking pale green when exposed to damp air.

2- It burns spontaneously "automatically" آنياً in air at room temperature due to enough الأكسدة التامة oxidation.

*Releasing phosphorous pentoxide (P_2O_5), see the following equation:

$$P_4 + 5O_2 \longrightarrow 2P_2O_5$$

*Under other conditions, (limited amount of oxygen) white phosphorous oxidizes to form phosphorous trioxide P_2O_3 as in the following equation:

$$P_4 + 3O_2 \longrightarrow 2P_2O_3$$

3- White Phosphorous is a poisonous سام for cells of living things whereby it penetrates تخترق into the digestive system الجهاز الهضمي and dissolves in the digestive ulcers القرحة الهضمية, turning into a poison تتحول الى سم, unlike red phosphorous, which doesn't dissolve in the ulcers.

Q\ Complete :

- There are other types of phosphorus , like red, black or purple), the most common is white and red phosphorus.

Q\ Why is White Phosphorus more active than red phosphorus under normal temperatures?

Because atoms of these two forms of phosphorus differ in the way that they bind.

الكيميائي التألق الفسفرة / المعان

Q\ Define Chemical luminance or "glitter"

يتوهج باهت

Glitter : It is process of White phosphorous glows in the dark, looking pale

الهواء الرطب يرافقه الثوم تشبه رائحة

green when exposed to damp air accompanied by garlic-like odor.

Q\ Why is White Phosphorus a poisonous for cells of living things? unlike red phosphorus.

White Phosphorus penetrates into the digestive system and dissolves in the digestive ulcers, turning into a poison, while red phosphorous doesn't dissolve in the ulcers.

Q\ What are the different between white Phosphorus and red Phosphorus?

White phosphorous	Red phosphorous
1. Translucent, white to yellowish color	1. Its external surface is red to violet color.
2. Produced in the rod form and stored under water because of its activity.	2. Produced in powder form it isn't affected by air at ordinary condition.
3. Lower density than the red.	3. Higher density than the white.
4. Soluble in some organic solvents such as carbon disulfide but insoluble in water.	4. Insoluble in organic solvents and water.
5. Its melting point is low.	5. Sublimates by heating.
6. Its flash point is low so it burns easily.	6. Its flash point is high.
7. It is poisonous.	7. It is not poisonous.

Q\ Define Phosphoric Acid , Phosphate

Phosphoric Acid: It is a densely formed, colorless, odorless liquid and weak non-oxidative acid. It has chemical formula (H_3PO_4)

Phosphate: one of the salts that is included in the composition of phosphorus as a basic element and chemical formula (PO_4^{-3}) such as sodium phosphate (Na_3PO_4) and calcium phosphate

Q\ What are the properties of Phosphoric Acid?

1- Phosphoric Acid (H_3PO_4) A densely formed.
2- Colorless and odorless liquid.
3- This acid is weak non-oxidative acid.
4- It reacts with bases forming phosphorous salts, such as Na_3PO_4.

Q\ Fill the blanks

1- sodium phosphate is used as preservative for some food products and meat.
2- Phosphoric Acid has major importance in manufacturing phosphate fertilizers.

Q\ What are the Industrial Uses of some Phosphorous compounds?

1- Matchsticks (أعواد الثقاب)   2- Phosphate Fertilizers. (الأسمدة الفوسفاتية)

Q\ Why are Matchsticks processed (معاملة) by Ammonium Phosphate solution $(NH_4)_3PO_4$

1. This material helps burn the matchstick in a smokeless flame.
2. It helps keep the flame burning completely.
3. It also ensures the stick put off when the flame goes off.

Q\ What are the components of a paste matchstick?

a- Flammable material like antimony sulfide Sb_2S_3.

b- An oxidant, like Potassium Chlorate, $KClO_3$.

الاحتكاك
c- Friction material like glass powder.

لاصقة مكونات العجينة
d- Glue material to bind the ingredients of the paste.

Q\ Explain the matchmaking process.



When the top of the matchstick is rubbed (يُفرك) against the side of the box, which contains red phosphorous, a sufficient heat is generated to ignite (لإشعال) the side of the box then this ignition transfer to the top of the matchstick and it burns.

Q\ Why is Phosphorous very important to prepare Phosphate Fertilizers?

Phosphorous is an essential element in the growth of plants, it plays a vital role (دوراً حيوياً) in the life of living beings and the development (يطور) of the skeletal (الهيكل العظمى) structure of animals and humans.

Q\ Phosphorous forms soluble compounds such as calcium phosphate (the original source of phosphate in nature),why?

Because it is a salt that is fairly insoluble (غير قابل للذوبان ال حد ما) in water, it is necessary to transform it into a salt easily soluble in water to be used as a fertilizer.

Q\ Define Super-phosphate fertilizer, Triple super-phosphate.

Super-phosphate fertilizer: It is fertilizer produced from calcium phosphate (Naturally found in rocks) is processed with sulfuric acid, This fertilizer is used to increase soil fertility.

Triple super-phosphate : It is other kinds of phosphate fertilizers can be prepared through the reaction of phosphoric acid with calcium phosphate it has chemical formula $Ca(H_2PO_4)_2$.

Q\ How can you prepare super-phosphate fertilizer by the equation?

$$Ca_3(PO_4)_2 + 2H_2SO_4 \longrightarrow Ca(H_2PO_4)_2 + 2CaSO_4$$

Q\ Why is Triple super-phosphate far much better than ordinary phosphate?

Because, it contains calcium sulfate.


Use of Fertilizers

Q\ where does the calcium phosphate occur?

Large amounts are found in Rutba region, in Akashat at Anbar province.

يوجد على شكل كميات كبيرة في منطقة الرطبة ، في عكاشات في محافظة الأنبار.

CHAPTER QUESTIONS 07

7-1 Complete the following statements:

1- Atomic number of nitrogen is 7 therefore its nucleus contains 7 proton Which 7 electrons rotate around of nucleus.

2- Atomic number of phosphorus is 15 therefore it nucleus contains 15 proton, which 15 electrons rotate around of nucleus.

3- A match's tip is coated with a paste, which consist of the following substance:

a) An inflammable material such as antimony sulfide Sb_2S_3

b) An oxidizing material such as Potassium Chlorate, $KClO_3$

c) A material that increases the friction force such as glass powder

4- Nitrogen has diatomic molecule in nature. Chemical symbol of nitrogen N_2

5- NH_3 is symbol of ammonia molecule. This molecule consists of 1 molecule nitrogen and three atoms hydrogen

6- What are the benefits of fertilizer of phosphate?

1) Essential in the growth of plants
2) It plays a vital role in the life of living beings
3) The development of the skeletal structure of animals and humans

7-2 Choose the correct answer.

1- Which one of the following percentage of nitrogen in earth's atmosphere?

a) 21% b) 78% c) 50%

2- Which of the following compounds is used in preparation of nitrogen gas in laboratory?

a) Copper oxide

b) Calcium Chloride

c) Ammonium Chloride and sodium nitrite in the presente of water.

3) Among those substances, whereas phosphorus enters their structure a substance directly used as phosphate fertilizer; this substance is

a) Bones

b) Natural calcium phosphate

c) Super phosphate

4) Which one of the following can be a proof that shows presence of ammonia in a solution?

a) It turns red litmus to blue.

b) It turns blue litmus to red.

c) It turns red litmus to yellow.

5) Heat of your hand is sufficient to ignite one form of phosphorus element, thus it should not be handle with hand when it is used in experiments for studying the phosphorus properties. This form is

a) Red phosphorus b) White phosphorus

6) Which method is used to preparation of Nitric acid in industry?

a) Heating of Potassium nitrate salt and concentrated Sulfuric acid mixtures;

b) Oxidizing of ammonia by using catalyst platinum in atmospheric pressure.

c) Separation of ammonia molecule in aqueous solution Dissociation

7) When phosphorous burns in enough of air, mostly produces

a) Phosphorous trioxide

b) phosphorous pentoxide

c) phosphorous nitrate

7-3 Complete the following reactions then balance them and write name of reactants and products.

a) $2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3$

b) $Ca_3(PO_4)_2 + 2H_2SO_4 \longrightarrow Ca(H_2PO_4)_2 + 2CaSO_4$

c) $2Ca_3(PO_4)_2 + 6SiO_2 + 10C \xrightarrow{1500C^\circ} 6CaSiO_3 + 10\,CO + P_4$

7-4 Mark the following sentences as true (T) or false (F) after that correct the false sentences.

a) Phosphorous element existed compound form in the nature. **(T)**

b) Highly temperatures are used preparation of ammonia in industry. **(F)** High pressure

c) Nitrogen has five electrons in outermost energy level. It can be composed single or multiple covalent bond. . **(T)**

d) Compounds which are called "phosphate" are salt of common phosphoric acid H_3PO_4. **(T)**

e) White phosphorus is poisonous material thus it is stored under water. **(F)** It is high flammability in air.

f) Red phosphorus is stored in the water container bottles. **(F)** White

g) White phosphorus is more reactive than red phosphorus, where as they are two forms for same element. **(T)**

h) The color of pure Nitric acid after a while becomes yellow after a while. **(T)**

م.م. محمود علي النجم
ثانوية كلية بغداد
ماجستير كيمياء
07711841751

chapter 8

كيمياء المتميزين مع النجم



YouTube النجم في الكيمياء



Chapter 8

ELEMENT OF VIA GROUP

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub						

عزيزي الطالب – عزيزتي الطالبة
سوف تكون الترجمة فقط للكلمات التي لم تذكر في الفصول السابقة.

Group VIA

Q\ What are the elements of group VIA :

They include five elements; Oxygen (O), Sulfur (S), Selenium (Se), Tellurium (Te), Polonium (Po).

Q\ Why are oxygen and sulfur in the same group?

Because, they have six electrons in their outer shells.

Q\ What are the characteristics of group VIA?

1- Oxygen and sulfur are considered as non-metal while selenium and tellurium have semimetal properties, as for polonium, it has pure metal properties.

2- Elements of the group VIA has six electrons in the outer shell which make them "hunt" (كسب) two electrons from other elements in order to have a stable electron configuration similar to that of noble elements.

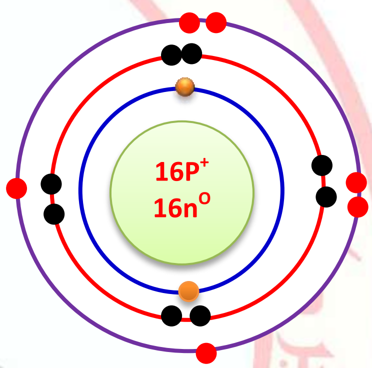
Q\ Why do elements of the group VIA hunt two electrons from other elements?

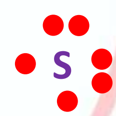
In order to have a stable electron configuration similar to that of noble elements.
لاجـــــــــل

SULFUR الكبريت

Q / Give the following to the Sulfur element: Chemical symbol, Atomic number, Mass number and then Draw the electronic configuration.

chemical symbol	S
atomic number Z	16
mass number A	32
electronic configuration	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
Number of proton Number of electron	$z = p^+ = e^- = 16$
Number of neutron	n = A – Z n= 32 - 16 n = 16





Q\ Where does the Sulfur element occur?

1- It is found in nature freely in special sulfur mines (مناجم) in Mosul city.

2- It is also found in volcanic (البركانية) regions in large quantities in the form of compounds such as hydrogen sulfide H_2S and sulfur dioxide SO_2.

Q\ Explain the Preparation of sulfur in Laboratory.

Sulfur can be prepared in laboratory by adding concentrated hydrochloric acid to sodium thiosulfate, $Na_2S_2O_3$ (at -10°C). Sulfur precipitates and collected through filtration according to the following reaction equation:

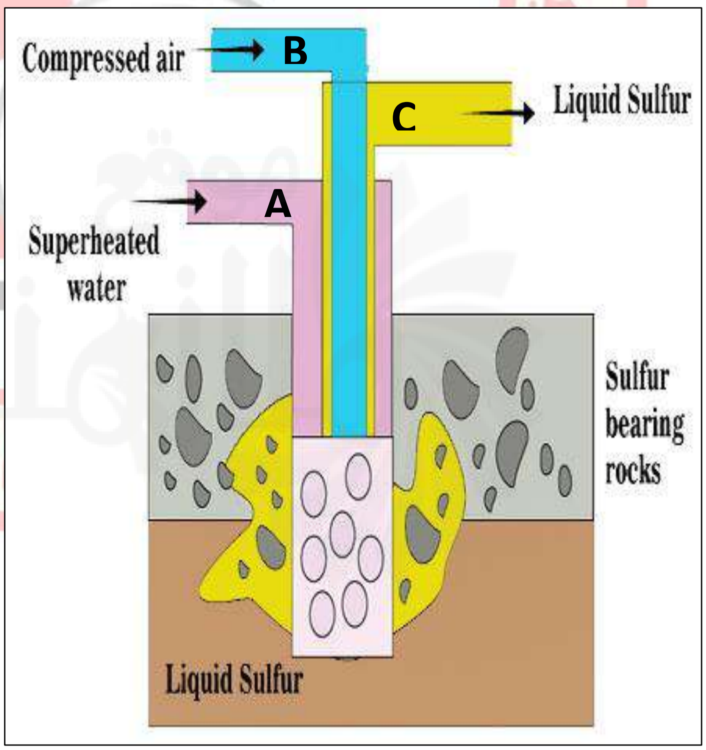
$$2HCl + Na_2S_2O_3 \longrightarrow S\downarrow + SO_2\uparrow + 2NaCl + H_2O$$

استخراج
Q\ Explain extraction process of Sulfur form of underground.

فراش طريقة
Q\ Explain Frasch Process.

This process done by melting sulfur underground by means of special equipment's:

1. Extend three overlapping tubes (A-B-C) pivotally in underground. (مد، متداخلة، بشكل محوري)
2. Pressurized and superheated to 170°C water vapor is pushed into the outer tube (A) to where sulfur converges, this pressure melts sulfur underground. (مضغوط، مسخن، يجمع)
3. Passes the pressurized air from tube B.
4. Lifts up molten sulfur through tube C mixed with some air bubbles. (يرفــع)
5. Molten sulfur is casted in large basins and left to cool down and solidify. (أحواض)
6. Much of the sulfur produced by using this process is 99.5 % - 99.9 % pure , therefore in needs no further re-purification



Q\ Define Frasch Process.

Frasch Process: is Process used to extraction of Sulfur form of underground.

Q\ why doesn't sulfur produced by Frasch process needs to re-purification?

Because, sulfur produced by using this process is 99.5 % - 99.9 % pure.

Q\ What are the physical properties of Sulfur?

1. It is yellow solid substance at STP.
   مميزة
2. Tasteless, with distinctive odor.
3. Insoluble in water, yet dissolves in some inorganic solvents like carbon disulfide, CS_2.
4. Non-conductor of electricity.
5. It Has various forms in nature with variant physical properties with 8 atoms (S_8).

Q\ What happens to the evaporation carbon disulfide?

Sulfur with 8 atoms (S_8) deposits gradually in the form of crystals.

صور

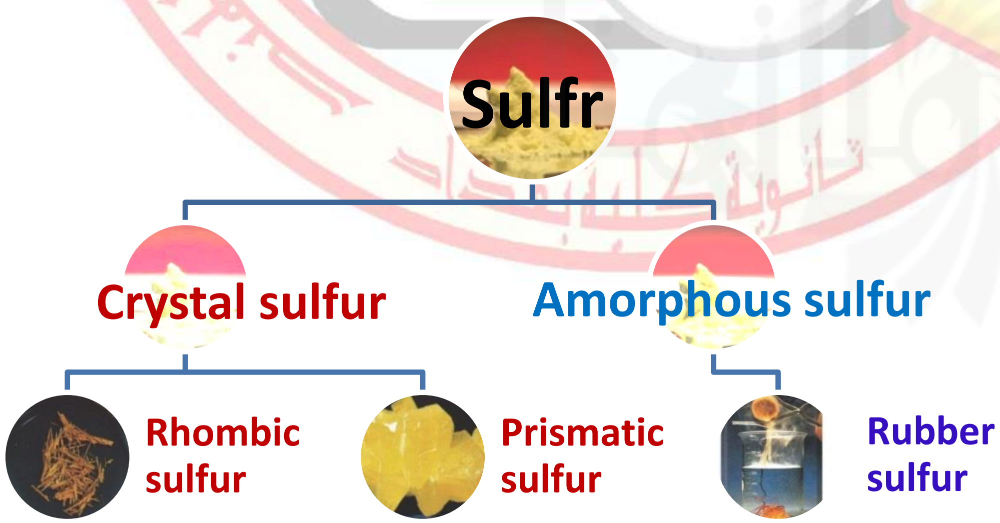
Q\ Define allotropic elements

Allotropic Elements: They are various forms in nature with variant physical
على الرغم
properties which vary in physical form, color , despite
ينتمون
belonging to the same element.

Q\ Write the allotropic of sulfur.

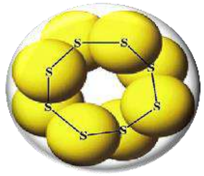
معيني موشوري
1- Crystal sulfur (Rhombic sulfur, prismatic sulfur)

2- Non-crystalline sulfur (rubber or plastic sulfur)



Q\ Define Rhombic sulfur .

Rhombic sulfur: It is the most common type of crystal sulfur, it is a yellow crystal (like lemon), stable at room temperature. It is the most stable form of sulfur. It is found as cyclic S_8 molecule in volcanic areas.



Q\ Why is prismatic sulfur called by this name?

Because its crystals look like prism. موشور

Q\ Define rubber or plastic sulfur.

Rubber sulfur: المطاط It is amorphous sulfur. It is less stable than crystal sulfur, it turns to crystal sulfur gradually Sulfur has the formulas; S_8 and S_6.

Q\ Prepare rubber or plastic sulfur.

It can be prepared by heating sulfur to $1500^{O}C$ and pouring the liquid sulfur into cold water, whereby spiral chains are formed.

Q\ S_8 form is more active than S_6 form , why?

Due to the high tension of the rhombic ring. (الشديد توتر)

Q\ What are the chemical properties of Sulfur?

1. Sulfur is not reactive under normal temperature.
2. Reacts with almost all elements directly under the appropriate temperature.
3. Sulfur burns easily in air producing blue flame, heat and sulfur dioxide.
4. Sulfur reacts with carbon to produce carbon disulfide, CS_2.
5. Sulfur reacts with metals like iron, copper and zinc to produce metal sulfides.
6. Reaction with concentrated and oxidized acids, and no affected by dilute acids.

Q\ write the equations for :

1- Sulfur burns

$$S + O_2 \xrightarrow{\Delta} SO_2$$

2- Sulfur reacts with carbon

$$2S + C \xrightarrow{\Delta} CS_2$$

3- Sulfur reacts with iron metals

$$S + Fe \xrightarrow{\Delta} FeS$$

4- Sulfur reacts with concentrated acids (sulfuric acid , nitric acid)

$$S + 2H_2SO_4 \xrightarrow{\Delta} 3SO_2 + 2H_2O$$

$$S + 6HNO_3 \longrightarrow H_2SO_4 + 6NO_2 + 2H_2O$$

Q\ What are the uses of Sulfur?

عود الثقاب البارود الألعاب النارية
1- In manufacturing matchsticks and black gunpowder and fireworks because of high flammability.

زراعة
2- It is used in agriculture to balance earth alkaline as well as a fertilizer.

3- It is used to produce sulfuric acid, paints and dyes.

مصفاه تطوير
4- It is used mining metals and oil refinery, developing films and in drug industry.

Q\ Why does Sulfur use in manufacturing matchsticks and black gunpowder and fireworks?

بارود

Because its high flammability.

Q\ Where does Sulfur dioxide SO_2 occur?

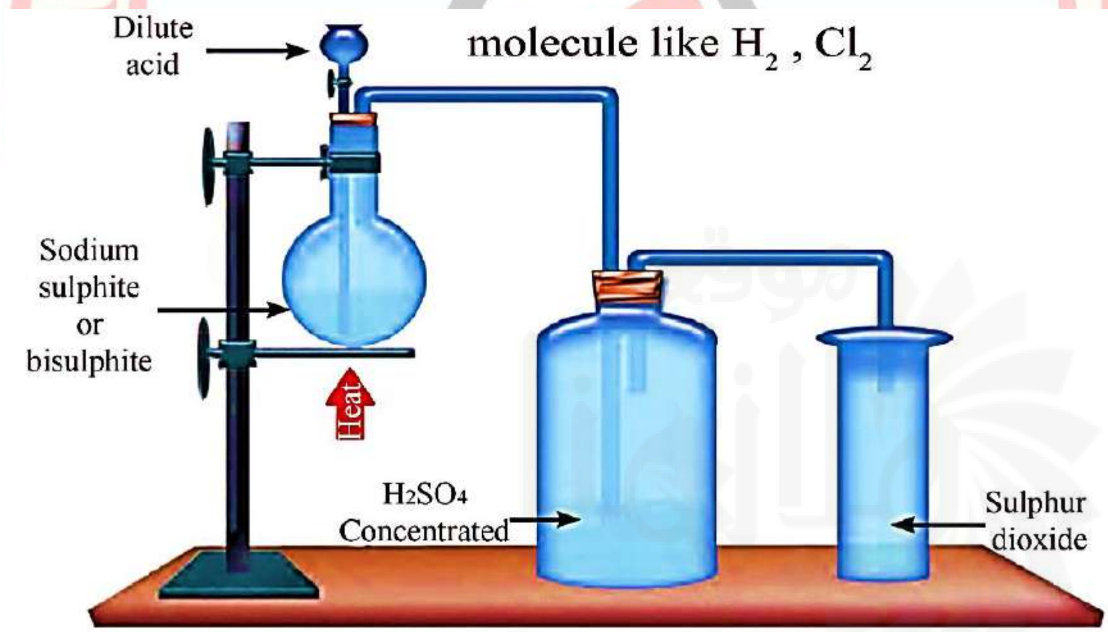
SO_2

1- SO_2 is produced by burning sulfur with oxygen gas.
2- This gas naturally evaporates in large quantities from volcanic activities. (البركانية)
3- It is produced from some industrial processes during mining of some substances.
4- By burning of petroleum derivatives and briquette. (النفط - مشتقات - الفحم الحجري)

Q\ Explain the preparation method of Sulfur dioxide in laboratory.

Sulfur dioxide is prepared at laboratory by adding dilute sulfuric acid to sodium sulfite, (Na_2SO_3). It can be collected by pumping air out from above because it is heavier than air. As in the following equation:

$$Na_2SO_3 + H_2SO_4 \longrightarrow SO_2 + H_2O + Na_2SO_4$$



Q\ SO_2 can be collected by pumping air out from above, why?

Because it is heavier than air.

Q\ What are the physical properties of Sulfur dioxide gas?

1- Sulfur dioxide is a colorless gas
2- It has strong characteristic smell.
3- It is heavier than air.
4- It does not dissolve much in water producing a weak solution of sulfurous acid

Q\ Why does the color of the blue litmus paper turns to red when it is put in the gas collecting bottles Sulfur dioxide?

Because when dissolve in water producing a weak solution of sulfurous acid.

Q\ Complete by equation:

* sulfur dioxide react with water.

$SO_2 + H_2O \longrightarrow H_2SO_3$

Acid rains

Q\ What are uses of Sulfur dioxide?

1- Sulfur dioxide is commercially used in decolorizing (إزالة اللون) the delicate organic substances such as paper, straw (قش), artificial (الاصطناعي) silk and wool.
2- It used for sterilizing purposes.
3- It is used as a preservative (حافظة) agent in food industries.

Q\ Sulfur dioxide is commercially used in decolorizing the delicate organic substances such as paper, straw, artificial silk and wool. why?

Because:

1- They are changing when they are bleached with gas chlorine.
2- Most of the Sulfur dioxide bleached materials recover their colors as soon as they are exposed to air.

note

Sulfur can burn spontaneously in air at (400°C) with the existence of oxygen.

Q\What are the damages to sulfur dioxide gas?

A. This gas is bad for health.

B. It is the main cause of acid rains.

Q\ what are the physical properties of Hydrogen sulfide

1- It is a colorless gas

2- It has characteristic foul odor such as odor of rotten eggs. (البيض الفاسد)

Q\ Where does Hydrogen sulfide occurs in nature?

result from:

1- The bacterial breakdown of the organic matters.

2- Underground water that contains sulfur as in the mineral water wells in Hammam Al-Aleel in Nineveh Province north of Iraq.

3- From the biological activity of some kinds of bacteria that rely of iron and manganese as part of their food sources.

4- Natural gas contains 28% of hydrogen sulfide and it may.

5- From some the industries that use sulfur compounds.

Q\ Explain the preparation method of hydrogen sulfide gas.

Hydrogen sulfide gas can be produced in laboratories using the same device used to produce SO_2. The device is based on the reaction of the diluted acids such as sulfuric acid with metal sulfides such as iron (II) sulfide as in the following equation: $FeS + H_2SO_4 \longrightarrow H_2S + FeSO_4$

Q\ Explain the test of hydrogen sulfide gas through in its solutions.

By Pass hydrogen sulfide gas through in the solutions of metal ions like copper (II) sulfate results in a black precipitation of copper (II) sulfide according to the following equation:

$$H_2S + CuSO_4 \longrightarrow H_2SO_4 + CuS\downarrow$$

Q\ Fill the blanks:

1- Chemical formula of Sulfuric Acid (H_2SO_4)
2- Sulfuric Acid (H_2SO_4) is one of the earliest acids identified by man in ancient times.
3- Sulfuric Acid is soluble in water at all concentrations and its solutions have high electrical conductivity.

Q\ Define Sulfuric acid

Sulfuric acid: is a colorless oily liquid with high density and has no characteristic smell when it is pure. It is a highly corrosive strong acid.

Q\ Explain industrial method of Sulfuric Acid.

1- Sulfuric acid can be industrially manufactured by contact process, which simply involves the reaction between sulfur and oxygen to produce sulfur dioxide:

$$S + O_2 \rightarrow SO_2$$

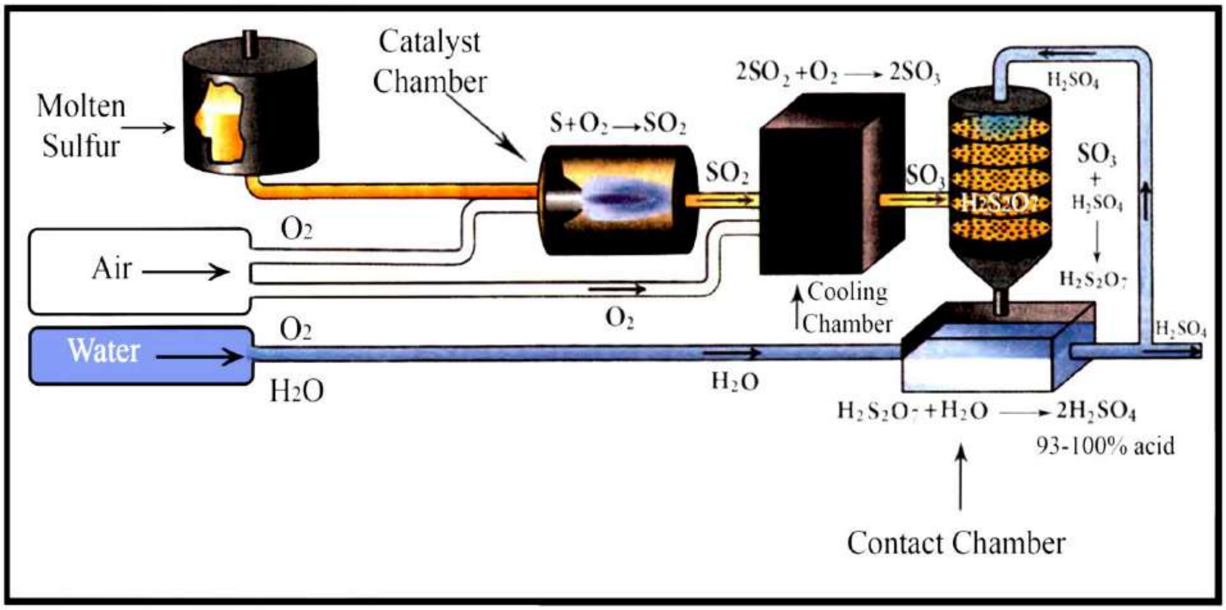
2- Sulfur dioxide is pumped into chamber which contains catalyst to obtain sulfur trioxide.

$$2SO_2 + O_2 \rightarrow 2SO_3$$

3- After that sulfur trioxide is dissolved in water

$$SO_3 + H_2O \rightarrow H_2SO_4$$

الرسم في الصفحة الأخرى



Q\ What are the physical properties of Sulfuric acid?

1- It is a colorless liquid
2- Oily liquid will a high density of (1.84 g/cm^3)
3- It has no characteristic smell
4- It dissolves H_2O in water at all concentrations generating high temperature.

Q\ Cautions must be taken when reducing concentration of Sulfuric acid, why?

Because when it dissolves in water at all concentrations generating high temperature

Q\ why does Sulfuric acid used as a drying agen?

Because of its high ability to absorb water from the organic compounds.

Q \ what happens when we put a spoonful sugar in a bowl fully concentrated sulfuric acid?

We see that black carbonic substance results from the reaction in the bowl as in the following equation:

$$C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H2SO4} 12C + 11H_2O$$

Q\ what are uses of Sulfuric Acid?

1- It is used in the production of other acids such as nitric and hydrochloric acids.
2- It is used as a drying agent especially with the gases, which do not react with it.
3- It is used to refine (صقل) crude (الخام) oil and remove impurities.
4- It is used in the production of explosives like nitroglycerin nitrates and cellulose nitrates.
5- It is used as a cleaning agent to remove rust from the iron tools before being painted with Zinc.
6- It is widely used in the production of batteries and in the electrical coating (الطلاء).
7- It is used in the production of chemical fertilizers such as ammonium sulfates and phosphate fertilizers.

Q\ Give reason:

1- Sulfuric acid is used in the production of other acids such as nitric and hydrochloric acids.
   Because of its high boiling point.

2- Sulfuric acid is used as a drying agent especially with the gases which do not react with it
   Because of its high ability to react with water.

3- Sulfuric acid is widely used in the production of batteries (lead storage batteries) and also in the electrical coating
   because it has high electrical conductivity.

Q\ Define Sulfates

Sulfates: are sulfuric acid salts, which are derived from the reaction of sulfuric acid with the metals or with their oxides, hydroxides or carbonates.

Q\ Complete the following equation:

1- Zinc oxide + sulfuric acid →

$$ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$$

2- Zinc hydroxide + sulfuric acid →

$$Zn(OH)_2 + H_2SO_4 \longrightarrow ZnSO_4 + 2H_2O$$

3- Zinc carbonates + sulfuric acid →

$$ZnCO_3 + H_2SO_4 \longrightarrow ZnSO_4 + CO_2 + H_2O$$

Q\ Explain test of sulfate ion (SO_4^{-2}) Sulfate ions.

Q\ How can you identified sulfate ion in their aqueous solutions?

By adding the solution, which contains barium ions such as barium chloride.

The result is a white precipitation of barium sulfate:

$$BaCl_2 + SO_4^{2-} \rightarrow BaSO_4 \downarrow + 2Cl^-$$

$BaCl_2$	SO_4^{2-}	$BaSO_4 \downarrow$	$2Cl^-$
Barium chloride	Sulfate ion	Barium sulfate White precipitate	Chloride ion

CHAPTER QUESTIONS 08

8-1 Properties of VIA group elements are arranged from oxygen to polonium. Write the properties.

1- Oxygen and sulfur are considered as non-metal while selenium and tellurium have semimetal properties, as for polonium, it has pure metal properties.

2- Elements of the group VIA has six electrons in the outer shell which make them "hunt" two electrons from other elements in order to have a stable electron configuration similar to that of noble elements.

8-2 Write the common electron configuration of VIA group elements.

The reason is that it contains its last level 6 electrons so it needs two electrons to saturate its outer shell.

8-3 Choose the correct answer:

1- Sulfur element occurs, in nature, in the form of:
a) Only Free b) Only combined c) Free and combined

2- Some elements such as sulfur, phosphorous and carbon, occur in their solid states in different forms; they are characterized by these forms each other in some physical properties, these forms are called:

a) Allotropes of element b) Elements shape
c) Elements forms d) Elements types

3- One of the following free solid molecules contains eight atoms, that is...... .

a) White phosphorus b) Iodine c) Sulfur d) Carbon

8-4 What happens when hydrogen sulfide gas is passed in zinc sulfate, lead acetate, copper sulfate solutions, explain these using equations.

$$H_2S + ZnSO_4 \longrightarrow ZnS\downarrow + H_2SO_4$$

$$H_2S + (CH_3COO)_2Pb \longrightarrow PbS\downarrow + 2CH_3COOH$$

$$H_2S + CuSO_4 \longrightarrow CuS\downarrow + H_2SO_4$$

8-5 The underground deposit of sulfur is extracted in the Mishraq fields, according to Frasch process which three concentric pipes extended to different deep. Answer the following questions according to figure at page 4

a) What is the role of the pipe (B) in this process?

Passes the pressurized air from tube B.

b) Which material passes through the inside pipe (A)?

Pressurized and superheated to 170°C water vapor is pushed into the outer tube (A)

c) Explain how you could get water 170°C while it boils at 100°C.

It can be obtained by increasing pressure

8.6 If you have a mixture of very fine table salt, chalk and sulfur, describe an experimental method to separate these materials in dry and pure form.

1. Add water to melt the salt and separate the chalk and sulfur in the filtration method, evaporate the saline solution to get dry salt.
2. Add CS_2 solution to separate the sulfur because the sulfur dissolves in it and chalk does not dissolve, then filter, and dry.
3. Filter the chalk and leave to dry.

8-7 Write the reaction of sulfur with metal and non-metal.

With metal $S + Fe \xrightarrow{\Delta} FeS$

With non-metal $2S + C \xrightarrow{\Delta} CS_2$

8-8 Explain the preparation of Sulfuric Acid with industrial method.

1- Sulfuric acid can be industrially manufactured by contact process, which simply involves the reaction between sulfur and oxygen to produce sulfur dioxide:

$$S + O_2 \rightarrow SO_2$$

2- Sulfur dioxide is pumped into chamber, which contains catalyst to obtain sulfur trioxide.

$$2SO_2 + O_2 \rightarrow 2SO_3$$

3- After that sulfur trioxide is dissolved in water

$$SO_3 + H_2O \rightarrow H_2SO_4$$

8-9 Complete the following reaction:

$$FeS + H_2SO_4 \longrightarrow H_2S + FeSO_4$$

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

$$BaCl_2 + SO_4^{-2} \longrightarrow BaSO_4 + 2Cl^-$$